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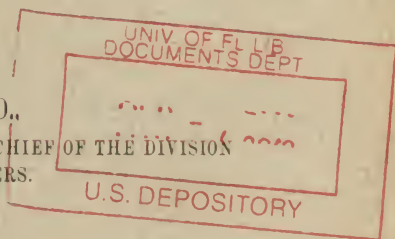
Issued July 20, 1908.

U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF CHEMISTRY—BULLETIN No. 84, PART IV.  
H. W. WILEY, CHIEF OF BUREAU.

INFLUENCE OF FOOD PRESERVATIVES AND ARTIFICIAL  
COLORS ON DIGESTION AND HEALTH.

IV.—BENZOIC ACID AND BENZOATES.

By H. W. WILEY, M. D.,  
WITH THE COLLABORATION OF W. D. BIGELOW, CHIEF OF THE DIVISION  
OF FOODS, F. C. WEBER, AND OTHERS.



WASHINGTON:  
GOVERNMENT PRINTING OFFICE.  
1908.

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Issued July 20, 1908.

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## LETTER OF TRANSMITTAL

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UNITED STATES DEPARTMENT OF AGRICULTURE,  
BUREAU OF CHEMISTRY,

*Washington, D. C., December 26, 1907.*

SIR: I beg to submit for your inspection and approval the results of the investigations which have been made in this Bureau to determine the effect of benzoic acid and benzoates upon digestion and health. The work is a continuation in plan of that described in Parts I-III of Bulletin 84. I recommend that this report be published as Part IV of Bulletin 84.

Respectfully,

H. W. WILEY,  
*Chief of Bureau.*

Hon. JAMES WILSON,  
*Secretary of Agriculture.*



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# INFLUENCE OF FOOD PRESERVATIVES AND ARTIFICIAL COLORS ON DIGESTION AND HEALTH.

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## IV.—BENZOIC ACID AND BENZOATES.

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### INTRODUCTION.

In the continuation of the work described in Parts I to III of this bulletin, experiments were conducted, according to the general plan already described, to determine the effects of benzoic acid and benzoates upon health and digestion. This investigation is of special importance because of the opinion held by many manufacturers, food officials, and consumers that benzoic acid and benzoates are probably the least harmful of the preservative substances employed. It is believed that for this reason there has been a very large increase in the use of these preservatives in the last few years with a corresponding decrease in the amount of other preservative substances employed. It has also been claimed that there can be no reasonable objection to the use of benzoic acid by reason of its natural occurrence in many food products, either in traces or in considerable quantities. Among the products cited the cranberry occupies the most prominent position because of the notable amount of benzoic acid it contains. These considerations, however, had no determining influence on the choice of this substance for the experimental work, inasmuch as it was included in the original scheme which was prepared before the work reported in Part I was begun.

The same principles which guided the organization of the work as described in Part I were followed in the present instance. Upon the selection of the members of the hygienic table each man was subjected to a thorough medical examination of the character already described. No one was admitted to the table who was suffering from any organic disease, who manifested any tendency to hereditary disease, or who had been seriously ill within the year previous to the beginning of the experimental work.



The delay which has attended the presentation of this report for publication has been due to several causes. First, the great burden of collating the data, condensing the analytical tables, and checking the data for accuracy, required, as is usual in such cases, a large amount of time and expert labor. There were also a number of points brought out in the investigations which required further study of the question, both experimentally and in consulting authorities thereon.

Another reason for the delay consisted in the fact that various representations were making on the part of manufacturers and others respecting the effect upon the industries using benzoic acid should the conclusions reached in this report receive executive and judicial confirmation. It was thought advisable, therefore, to give ample time to the industries involved to experiment with methods of manufacture looking to the elimination of objectionable preservatives. Investigations were also undertaken by this Bureau in collaboration with the manufacturing interests along the same line. Results of these investigations have shown that there is not a single article of food which has been commonly preserved by means of benzoic acid or benzoate of soda which cannot be preserved and offered to the consumer in perfect condition without the aid of any chemical preservative. This fact has been completely demonstrated in the case of cider and grape juice, mince-meat, jelly, jams, catsups, preserves, and other articles of the same character, and there seems, therefore, to be no longer any industrial reason for delaying publication even if the former necessity for such delay be admitted.

It is believed that the distribution of the results of this investigation at the present time will neither work hardship to any manufacturing interest nor interfere in any way with any legitimate business. At the same time it will indicate to the manufacturer, as well as to the consumer, the important truth that the use of benzoic acid or benzoate of soda as a preserving medium is not without danger, that its effects are always injurious or tend to injury, and that its exclusion from food products is desirable not only in order to conform to the food and drugs act, but also for hygienic reasons.

The greater care which is required in the manufacture of food products without the use of benzoic acid or benzoate of soda, necessitating the use of a higher quality of raw material, will place the industries which would otherwise use these preservatives in foods on a better plane, and secure for their products a greater consumption.

## SERIES VIII.

## ADMINISTRATION OF THE PRESERVATIVE.

In Table I are recorded the dates of the periods and subperiods during which this experiment was conducted. A preliminary or relaxation period of one month elapsed between the close of Series VII and the beginning of Series VIII, the subjects being the same in both series with the exception of No. 4.

TABLE I.—*Dates of periods and subperiods in Series VIII.*

Period and subperiod.	Date of beginning.	Date of ending.
Fore period.....	1904. April 11	1904. April 20
First subperiod.....	...do... April 15	April 15
Second subperiod.....	April 16	April 20
Preservative period.....	April 21	May 10
First subperiod.....	...do... April 25	April 25
Second subperiod.....	April 26	April 30
Third subperiod.....	May 1	May 5
Fourth subperiod.....	May 6	May 10
After period.....	May 11	May 20
First subperiod.....	...do... May 15	May 15
Second subperiod.....	May 16	May 20

In Table II is given a schedule of the administration of the preservative. The sodium benzoate used is calculated in the table as benzoic acid. The preservative was given in all cases in capsules, as experience had shown this to be the best method from every point of view of administering a substance of this nature.

In the first preservative subperiod there was given to Nos. 1 to 6, inclusive, one gram of benzoic acid per day; to Nos. 7 to 12, inclusive, one gram per day with the exception of the first day when only 0.9 gram was given. During the second preservative subperiod 1.5 grams of benzoic acid were given each day to each member. In the third preservative subperiod 2 grams, and in the fourth 2.5 grams were given each day, with the exceptions noted in the table. There were several cases during the fourth subperiod when the preservative, by reason of its ill effects and for other causes, had to be withdrawn. The maximum quantities of benzoic acid, therefore, given during the entire preservative period are 35 and 34.9 grams, and only three men were able to take these amounts. In all of the other cases it was necessary to withdraw a portion or all of the preservative for the reasons already stated.

TABLE II.—*Schedule of administration of preservative, Series VIII.*

[In capsules.]

Period and date.	Benzoic acid.					Sodium benzoate (expressed as benzoic acid).						
	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.	No. 9.	No. 10.	No. 11.	No. 12.
First subperiod:	<i>Gms.</i>	<i>Gms.</i>	<i>Gms.</i>	<i>Gms.</i>	<i>Gms.</i>	<i>Gms.</i>	<i>Gms.</i>	<i>Gms.</i>	<i>Gms.</i>	<i>Gms.</i>	<i>Gms.</i>	<i>Gms.</i>
April 21, 1904.....	1	1	1	1	1	1	0.9	0.9	0.9	0.9	0.9	0.9
22, 1904.....	1	1	1	1	1	1	1	1.0	1.0	1.0	1.0	1.0
23, 1904.....	1	1	1	1	1	1	1	1.0	1.0	1.0	1.0	1.0
24, 1904.....	1	1	1	1	1	1	1	1.0	1.0	1.0	1.0	1.0
25, 1904.....	1	1	1	1	1	1	1	1.0	1.0	1.0	1.0	1.0
Total per individual.....	5	5	5	5	5	5	4.9	4.9	4.9	4.9	4.9	4.9
Second subperiod:												
April 26, 1904.....	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
27, 1904.....	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
28, 1904.....	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
29, 1904.....	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
30, 1904.....	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Total per individual.....	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Third subperiod:												
May 1, 1904.....	2	2	1	2	2	2	2	2	2	2	2	2
2, 1904.....	2	2	0	2	2	2	2	2	2	2	2	2
3, 1904.....	2	2	0	1.5	<sup>a</sup> 1	2	2	2	2	2	2	2
4, 1904.....	2	2	0	2.5	1	2	2	2	<sup>a</sup> 2	2	2	2
5, 1904.....	2	2	0	2	2	2	2	2	2	0	2	2
Total per individual.....	10	10	1	10.0	8	10	10	10	10	8	10	10
Fourth subperiod:												
May 6, 1904.....	2.5	2.5	0	2.5	2	0	1.5	2.5	0	0	2.5	0
7, 1904.....	2.5	0	0	2.5	1	0	2.5	2.5	0	0	0	0
8, 1904.....	2.5	0	0	2.5	0	0	2.5	2.5	0	0	0	0
9, 1904.....	2.5	0	0	2.5	0	0	0	2.5	0	0	0	0
10, 1904.....	2.5	0	0	2.5	0	0	0	2.5	0	0	0	0
Total per individual.....	12.5	2.5	0	12.5	3	0	6.5	12.5	0	0	2.5	0
Total per individual for entire preservative period.....	35.0	25.0	13.5	35.0	23.5	22.5	28.9	34.9	22.4	20.4	24.9	22.4

<sup>a</sup> Took preservative, but became sick immediately afterwards.**EXCRETION OF HIPPURIC AND BENZOIC ACID.**

In Table III are given the results of the determinations of hippuric and benzoic acid in the urine during the entire time of observation.

**METHOD FOR DETERMINING HIPPURIC AND BENZOIC ACID IN THE URINE.**

The method employed was that described by Bunge and Schmiedeberg.<sup>a</sup> The essential features of the method are as follows:

Make alkaline 100 to 200 cc of urine with sodium carbonate, evaporate to dryness, and extract the residue with alcohol. Completely distill off the alcohol, make the remaining water solution acid with hydrochloric acid and extract at least five times with acetic ether. Wash the acetic ether extract with water and then evaporate.

<sup>a</sup> Arch. exp. Path. Pharmakol., 1876, 6: 235; also Analyse des Harns, Neubauer and Vogel, 1898, p. 226.



Purify the hippuric acid and benzoic acid, crystallize, and weigh. Separate the hippuric acid from benzoic acid by means of petroleum ether; the difference in weight of the crystalline forms is benzoic acid.

The method is not as exact as could be desired and presents many difficulties, particularly in the case of concentrated urines, where a considerable quantity of fatty and resinous matter is removed by the acetic ether employed to extract the benzoic and hippuric acids. As in other determinations the analyses were made on composited samples.

Hippuric acid occurs as a normal constituent of human urine in amounts varying from 0.1 gram to 1 gram per day (Analyse des Harns, Neubauer and Vogel), and in some cases after eating freely of vegetables and fruit, especially plums, cranberries, etc., it may be more than 2 grams per day.<sup>a</sup> In the ordinary mixed diet the average quantity of hippuric acid eliminated is given as 0.7 gram per day.

Hippuric acid is the chief nitrogenous constituent in the urine of herbivora. This is explained by the fact that animals feeding wholly on vegetable foods consume a large amount of aromatic substances, which, by oxidation, as toluol (cinnamic acid), or by reduction, as quinnic acid, are converted into benzoic acid, or substances containing the benzene nucleus, and then, by combination with glycocoll, are converted into hippuric acid and excreted as such.

The formation of hippuric acid in the human organism is therefore associated with the formation of benzoic acid. It has been proven conclusively, both synthetically and by feeding experiments, that hippuric acid is formed as the resulting product of the union of benzoic acid, or a substance containing the benzene nucleus, and glycocoll. Thus any substance or material taken with the food which contains the benzene nucleus or is capable, by oxidation or reduction, of being converted into benzoic acid will unite with glycocoll, which is derived from the protein metabolism within the body, to form hippuric acid.

There are also a few cases where the benzoic acid is derived solely from protein. Salkowski, Meissner, Shepard, and others found hippuric acid in the urine of starving dogs, also in dogs' urine after a diet consisting entirely of meat. The benzoic acid in these cases evidently originated from the putrefaction of protein in the intestines.

The amount of hippuric acid eliminated is influenced, first, by the amount of glycocoll present, and, second, by the amount of benzoic acid formed. If there is sufficient glycocoll formed during the digestion of proteins to combine with the benzoic acid, then all will

<sup>a</sup> Hammarsten, *Physiological Chemistry*, 1904.

be eliminated as hippuric acid. Experiments have been conducted on rabbits by Wiener,<sup>a</sup> in which he administered small amounts of benzoic acid and recovered the entire amount in the urine, combined with glycocoll, as hippuric acid.

#### DISCUSSION OF RESULTS.

Table II, page 1046, shows the daily ingestion of benzoic acid, and sodium benzoate in amounts equivalent to benzoic acid, during the preservative period.

In Table III are given the determinations of benzoic and hippuric acid for the fore period, preservative period, and after period. The table shows amounts of ether extract or benzoic acid, varying from 0.00 to 0.07 gram daily in the urine during the fore period, the amounts for Nos. 4 and 7 being quite high. The quantity of benzoic acid excreted in the preservative period varies from 0.064 gram, in the case of No. 11, to 0.784 gram in the case of No. 8. That benzoic acid remains in the system some time after its ingestion is shown by the increased excretion in the after period over the fore period. For Nos. 4, 7, 9, and 10 there is a diminished excretion in the after period as compared with that of the fore period. The average increase during the preservative period for Nos. 1 to 6, who received benzoic acid, is 0.159 gram over the fore period; for Nos. 7 to 12, who received sodium benzoate, there is an increased excretion of 0.255 gram over the fore period. The average increase in the after period over the fore period is 0.031 and 0.029 gram for Nos. 1 to 6 and 7 to 12, respectively.

In that section of the table which shows the excretion of hippuric acid, the variations in the amounts in the fore period are again quite marked, as in the case of benzoic acid, though there is apparently no general relation between the excretion of these two substances, the hippuric acid varying independently of the excretion of benzoic acid.

The amounts of hippuric acid excreted in the fore period vary from 0.330 gram per day for No. 6 to 1.118 grams per day in the case of No. 9. The average excretion for Nos. 1 to 6 during the fore period is 0.508 gram per day, while for Nos. 7 to 12, it is 0.784 gram.

During the preservative period there is, of course, an increase in the amounts of hippuric acid excreted, which again shows quite an individual variation. The average increase for Nos. 1 to 6 is 1.017 grams per day, and for Nos. 7 to 12, 0.677 gram per day over the fore period.

In the after period the average increase over the fore period is 0.293 gram per day for Nos. 1 to 6, and for Nos. 7 to 12 it is 0.062 gram.

<sup>a</sup> Arch. exper. Path. Pharmacol., 1874, 2: 313.



In the third section of this table the results are expressed and calculated in terms of benzoic acid, that is, the amount of hippuric acid found is calculated to benzoic acid and added to the ether extract considered as benzoic acid, given in the first part of the table.

The maximum amount of hippuric acid excreted (Part 2 of Table III) occurs in the third preservative subperiod, during which the largest amount of benzoic acid was administered. There is also quite a decrease in this period in the excretion of benzoic acid as compared with the previous subperiod.

In the summary of Table III, the entire amount recovered as benzoic and hippuric acids is 81.32 per cent for Nos. 1 to 6 and for Nos. 7 to 12 (No. 9 omitted) 61.41 per cent of the amount ingested. There is evidently a marked difference shown in the manner and amount in which the benzoic acid and the sodium benzoate are excreted.

It is also seen that the elimination of hippuric and benzoic acid had not returned to normal at the close of the after period and that the entire amount had not been eliminated at the close of the experiment. This point is further discussed in the supplemental study which follows.

It is very probable also that, under the conditions of the experiment, the supply of glycocoll in the body would not be sufficient in quantity at all times to combine with the benzoic acid ingested. Under the powerful oxidizing and reducing actions, to which the drug is subjected, various products resulting from this action as well as substitution products are doubtless formed, resulting in the elimination and destruction of part of the benzoic acid.

For the further elaboration of these points, especially the difference shown in the rate of elimination of the preservative when administered in the two forms, a supplementary study of the excretion of benzoic and hippuric acid was made.

#### SUPPLEMENTARY STUDY.<sup>a</sup>

##### PLAN OF THE EXPERIMENT.

The supplementary study included six subjects, and was begun on November 26, 1907. The experiment was divided into a fore period of five days, a preservative period of ten days, and an after period of fourteen days, during which the diet was kept practically constant. A somewhat longer after period in this case was deemed necessary, as the data obtained in the previous investigation indicated a considerable lag in the excretion of the ingested benzoic acid, particularly in the case of the benzoate of soda.

During the preservative period a total of 12.5 grams of benzoic acid was given to Nos. 1, 2, and 3, and an amount of benzoate of

<sup>a</sup> E. W. Brown and H. L. Amoss performed most of the analytical work in this investigation.

soda equivalent to this was administered to Nos. 4, 5, and 6, giving 1 gram per day the first five days and 1.5 grams per day during the second subperiod of five days.

#### ANALYTICAL METHOD USED.

The same method, essentially that of Bunge and Schmiedeberg, was employed in this investigation as in the original series, the details of its application in this case being as follows:

Evaporate 200 cc of urine to dryness on a steam bath after making alkaline with sodium carbonate. Extract the dry residue with hot alcohol (98 to 99 per cent), using a blunt glass stirring rod or a pestle to break up the coarse particles. Extract by using two 100 cc portions of alcohol and one 50 cc portion, heat to boiling each time and then filter. Finally wash the residue on the filter, using from 25 to 50 cc of cold alcohol. Evaporate the alcohol and take up the residue with 15 to 25 cc of water and transfer to a Squibbs separatory funnel of 200 cc capacity.

Extract five times with acid and alcohol-free acetic ether, using 50 cc for the first two portions and three 25 cc portions. Wash each portion of acetic ether extract with an equal volume of water saturated with acetic ether. Allow the combined extracts to evaporate spontaneously and, when the acetic ether has disappeared, transfer to weighed dishes by a small amount of acetic ether. Again evaporate the acetic ether and dry the residue in a vacuum oven at a temperature of 50° to 55° C. and a vacuum of 25 to 28 inches for six hours; cool and weigh.

After weighing extract the residue with from 20 to 30 cc of petroleum ether divided into three portions, dry in vacuo and again weigh. The final residue is hippuric acid and the difference due to the extraction with petroleum ether contains any benzoic acid that may be present as such.

As was pointed out in the previous study, this method is not as clear-cut as could be desired, but by the procedure described fairly accurate results were obtained and the residue of hippuric acid was in all cases crystalline and only slightly colored.

In order to test the degree of extraction and to determine whether any hippuric acid remained in the residue or was removed by washing the acetic ether with water, a series of these residues and wash waters were evaporated to dryness with excess of sodium carbonate and treated in the usual manner. In all cases only slight traces of crystals were obtained, showing the extraction to be fairly complete.

#### DISCUSSION OF ANALYTICAL DATA.

The results of the supplementary experiment are given in Table IV. The data are calculated, from the analysis, on the daily samples and also on the composites for each period, which were kept during the progress of the experiment. In the first test only composite samples were used, which probably accounts in part for such differences as are found in the two sets of results.

In part 1 of the table the results are given in terms of hippuric acid, obtained by direct weighing and also by titration of the final residue with tenth-normal sodium hydroxid. Unfortunately the

titrations were not made on the daily samples throughout, and these data are lacking for the first subperiod of both the fore and preservative periods. The titration figures given, however, serve to show that part of the residue which is weighed is not hippuric acid. It is believed that this is, at least in part, a compensating error, inasmuch as all the hippuric acid is probably not extracted and there is a slight loss during the washing of the acetic ether extract with water.

An inspection of the data shows an increase during the preservative period in the amount of hippuric acid excreted, which is much more marked in the case of the results on the daily samples than on the composites and also is much greater in the case of Nos. 1, 2, and 3, receiving benzoic acid, than for Nos. 4, 5, and 6, receiving benzoate of soda.

In the summary for Nos. 1, 2, and 3 there is in the fore period an average excretion by the daily samples of 1.1389 grams of hippuric acid as compared with 1.0361 grams by the composite samples. For Nos. 4, 5, and 6 the figures representing the excretion in the fore period are 1.0389 and 1.1954 for the daily and composite samples, respectively.

During the preservative period for Nos. 1, 2, and 3 the average excretion is 2.7677 grams for the daily samples and 2.2833 grams for the composites. For Nos. 4, 5, and 6 the same relation holds between the daily and composite samples and there is a marked decrease from the figures obtained for Nos. 1, 2, and 3, namely, 2.4127 and 1.5026 grams for the daily and composite samples, respectively.

One striking point in the data is the marked decrease in the amount of hippuric acid obtained for Nos. 4, 5, and 6 in the composite samples during the first preservative subperiod. No. 4 shows about one-fourth and Nos. 5 and 6 about one-third as much hippuric acid excreted during this period as is shown by the daily samples. There is, however, a corresponding increase (see part 2 of Table IV) in the amount of benzoic acid excreted, which was obtained in these instances in pure crystalline form and the amount titrated. The composited samples were not analyzed at the close of each period or subperiod, but were taken up at the close of the experiment. This particular composite probably stood twenty-five days, preserved with thymol and chloroform. As is well known, boiling with acids or alkalis decomposes hippuric acid into benzoic acid and glycocoll. There is a probability of such a decomposition having taken place in this instance, and this change is, moreover, of special interest, since it is confined to those subjects receiving benzoate of soda and occurs only during the first preservative subperiod. The average excess of hippuric acid excreted during the preservative period in the daily samples is 16.3072 grams for the subjects receiving benzoic acid and 13.7381 grams for those receiving sodium benzoate.



During the after period the excretion is still in excess of that of the fore period, amounting to 3.1646 grams for Nos. 1, 2, and 3 and 2.9884 grams for Nos. 4, 5, and 6 during the first subperiod, bringing the total excess per man up to 17.3621 grams and 14.7342 grams for those receiving benzoic acid and sodium benzoate, respectively. During the second after subperiod the excretion for Nos. 1, 2, and 3 is a little less than during the fore period, while for Nos. 4, 5, and 6 there is again an excess of 2.4263 grams over the fore period, bringing the total excretion from the sodium benzoate subjects up to 15.5430 grams per man. There is thus seen a marked tendency to an earlier excretion of the benzoic acid as hippuric acid than in the case of sodium benzoate.

In part 2 of Table IV the data are expressed in terms of benzoic acid. The total hippuric acid as determined by weighing the residue is calculated to benzoic acid. The residue obtained after the extraction with petroleum ether, which in the original experiment is regarded as benzoic acid, is marked "petroleum ether extract." In this experiment (with the exception of the incident with Nos. 4, 5, and 6 in the first preservative subperiod on the composite samples) no crystals were ever obtained in this extract, and, moreover, by collecting and keeping the individual extractions during the different periods, only slight traces of benzoic acid were recorded on one or two occasions, when tested by Mohler's method.<sup>a</sup> To further test this point two young men were given 2.5 grams of benzoic acid and two an equivalent quantity of sodium benzoate. In only one case was a positive reaction for benzoic acid obtained, and that was for one of the subjects receiving sodium benzoate. It is only fair to assume then that under the conditions of this experiment no benzoic acid as such was excreted in the urine. It must be remembered, however, that in the original experiment only the composite samples were analyzed and a larger amount of benzoic acid was ingested. It is possible, therefore, that under the conditions of the original experiment, in which the amounts of the preservative ingested were much greater, the supply of glycocholic acid was not sufficient to combine with all of the benzoic acid, and the petroleum ether extract in the first experiment did contain benzoic acid, although in the supplementary study the results indicate that the benzoic acid is all recovered as hippuric acid.

According to several authorities<sup>b</sup> benzoic acid is found in rabbits' urine and sometimes in small quantities in dogs' urine. It is also found in human urine in diseases of the kidneys. This occurrence of benzoic acid seems to be due to a fermentative decomposition of hippuric acid, such a decomposition readily occurring in an alkaline urine or in one containing proteid. According to Cushing<sup>c</sup> some

<sup>a</sup> U. S. Dept. Agr., Bureau of Chemistry, Bul. 107, p. 181.

<sup>b</sup> Cited in Hammarsten's *Physiological Chemistry*, 1904, p. 503.

<sup>c</sup> *Pharmacology and Therapeutics*, 1901, 2d ed., p. 412.

ingested benzoic acid escapes in the urine unchanged, this depending on the general health of the subject, the condition of the kidneys, and the amount administered. This is of considerable interest in relation to the point already brought out in regard to the benzoic acid excretion and also in connection with the lessened excretion of the hippuric acid when ingested as benzoate of soda.

The same relations hold in this part of the table in regard to the excretion, as were brought out in the discussion under part 1, as the benzoic acid is calculated directly from the hippuric acid. The weight of the extract, since it contains oxyacids, phenols, and resinous bodies, and was found to contain no benzoic acid, was not added to the calculated benzoic acid from hippuric acid. Further, this residue, if added to the data for the composite samples, is not sufficient to make up the deficiency between the composite samples and the daily samples, although in general there is an increased amount of "extract" for the composite samples over the daily samples, especially in the after period. This form of expressing the data merely affords a means of readily calculating the percentage amount, excreted as hippuric acid, of the amounts of benzoic acid ingested.

Based on the excess excreted in the preservative period 92.9 per cent of the amount ingested in the case of Nos. 1, 2, and 3 is recovered, while for Nos. 4, 5, and 6 only 71.9 per cent is excreted. There is again an increase in the first after subperiod, which brings the excretion for Nos. 1, 2, and 3 up to 100.5 per cent and for Nos. 4, 5, and 6 to 76.0 per cent. The excretion in the second and third after subperiods is practically of the same magnitude as that of the fore period for Nos. 1, 2, and 3, but in the case of the subjects receiving sodium benzoate there is still a slight increase in the second after subperiod, bringing the percentage excreted up to 77.6.

It is apparent that the rate of elimination and the total amount of hippuric acid eliminated are quite different under the influence of benzoic acid and of sodium benzoate. With benzoic acid the elimination seems to be complete within five days after its administration is discontinued, while in the case of sodium benzoate there is quite a retardation in the excretion, which extends at least over ten days, and 22.4 per cent of the amount ingested still remains unrecovered.

These results are in the main confirmatory of those obtained in the original series, in so far as they show the difference in the excretion of hippuric acid when derived from the ingestion of benzoic acid and from benzoate of soda; also the fact is brought out in this investigation that there is a disparity between the results on the daily samples and composite samples, evidently due to a decomposition of the hippuric acid taking place on standing, and that these subjects, with the ingestion of 12.5 grams of benzoic acid over a period of ten days, showed no benzoic acid excreted as such.



TABLE III.—*Excretion of the benzoic acid in the urine, Series VIII.*  
1. PETROLEUM ETHER EXTRACT (BENZOIC ACID).

Period.	Individual data.												Summaries.	
	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.	No. 9.	No. 10.	No. 11.	No. 12.	Nos. 1 to 6.	Nos. 7 to 12, a
<i>Fore period.</i>														
First subperiod:														
Total.....	Grams. 0.0000	Grams. 0.2022	Grams. 0.0000	Grams. 0.6589	Grams. 0.1088	Grams. 0.0323	Grams. 0.6897	Grams. 0.0000	Grams. 0.3469	Grams. 0.3536	Grams. 0.0000	Grams. 0.1916	Grams. 1.0022	Grams. 1.5818
Average.....		.0000	.0000	.1318	.0218	.0065	.1379	.0000	.0694	.0707	.0000	.0383	.0334	.0527
Second subperiod:														
Total.....	.0245	.1000	.0000	.0782	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.1806	.2927	.1806
Average.....	.0049	.0200	.0000	.0156	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0361	.0068	.0000
Entire fore period:														
Total.....	.0245	.3022	.0000	.7371	.1088	.0323	.6897	.0000	.3469	.3536	.0000	.3722	1.2049	1.7624
Average.....	.0025	.0302	.0000	.0737	.0109	.0032	.0690	.0000	.0347	.0354	.0000	.0372	.0201	.0294
<i>Preservative period.</i>														
First subperiod:														
Total.....	.1802	1.4500	.8966	.4553	.1673	.4671	.3576	2.6298	.2782	.4298	.2614	.8440	3.6225	4.8008
Average.....	.0360	.2912	.1793	.0911	.0335	.0934	.0715	.5200	.0556	.0860	.0523	.1688	.1208	.1600
Second subperiod:														
Total.....	.6793	4.7208	2.1083	1.5530	.6691	1.5029	4.7632	8.2835	.4403	.6195	.3336	2.5203	11.2334	16.9804
Average.....	.1359	.9442	.4217	.3106	.1338	.3006	.9526	1.6567	.0921	.1239	.0667	.5041	.3744	.5600
Third subperiod:														
Total.....	.4529	2.6769	.1857	.3022	.3696	.4719	.8294	.7898	2.1716	.5289	.5307	.9030	4.4592	5.7534
Average.....	.0906	.5354	.0371	.0604	.0739	.0944	.1659	.1580	.4343	.1058	.1061	.1806	.1486	.1918
Fourth subperiod:														
Total.....	.2200	.7298	.4159	.4275	.1799	.2618	.5732	3.9738	.....	.2257	.1572	.2120	2.2349	5.1419
Average.....	.0440	.1460	.0852	.0855	.0360	.0524	.1146	.7948	.....	.0451	.0314	.0424	.0745	.2057
Entire preservative period:														
Total.....	1.5294	9.5855	3.6065	2.7380	1.3859	2.7037	6.5234	15.6769	2.9101	1.8039	1.2829	4.4783	21.5500	32.6765
Average.....	.0766	.4792	.1803	.1369	.0693	.1352	.3262	.7838	.1940	.0902	.0641	.2240	.1796	.2841
<i>After period.</i>														
First subperiod:														
Total.....	.0202	.3485	.1446	.2658	.2873	.0584	.0413	.5004	.2785	.0000	.0994	.0000	1.0648	.9796
Average.....	.0040	.0697	.0289	.0412	.0575	.0117	.0083	.1121	.0557	.0000	.0199	.0000	.0355	.0327
Second subperiod:														
Total.....	.1548	.6303	.6138	.0000	.4160	.1561	.1808	.3730	.0000	.0652	.0000	1.9246	1.9770	2.5436
Average.....	.0310	.1273	.1228	.0000	.0832	.0312	.0362	.0746	.0000	.0130	.0000	.3849	.0659	.0848
Entire after period:														
Total.....	.1750	.9848	.7584	.2658	.7033	.2145	.2221	.9334	.2785	.0652	.0994	1.9246	3.0418	3.5232
Average.....	.0175	.0985	.0758	.0206	.0703	.0215	.0222	.0933	.0279	.0065	.0099	.1925	.0597	.0587

2. HIPPURIC ACID.

Fore period.																
First subperiod:																
Total.....	Grams.	6.3443	2.8288	3.0438	Grams.	1.9718	2.4795	6.1326	Grams.	2.4305	Grams.	3.1900	Grams.	4.0251	Grams.	22.0452
Average.....		1.2689	.5658	.6088		.3944	.4959	1.2265		.4861		.6398		.8046		.7348
Second subperiod:																
Total.....	Grams.	3.1999	1.6239	2.1840	Grams.	1.3314	2.5703	3.1279	Grams.	2.9406	Grams.	2.3270	Grams.	5.2765	Grams.	24.9910
Average.....		.6400	.3248	.4368		.2663	.5141	.6256		1.7497		.6398		1.0553		.8380
Entire fore period:																
Total.....	Grams.	9.5442	4.4527	5.2278	Grams.	3.3032	5.0498	9.2605	Grams.	11.1792	Grams.	5.5360	Grams.	9.2906	Grams.	47.0362
Average.....		.9544	.4453	.5228		.3303	.5030	.9261		1.1179		.5526		.9299		.7839
Preservative period.																
First subperiod:																
Total.....	Grams.	6.7025	5.5106	6.0351	Grams.	6.2705	4.8946	6.9258	Grams.	4.9648	Grams.	7.0953	Grams.	6.3983	Grams.	37.7317
Average.....		1.3405	1.1021	1.2070		1.2541	.9789	1.3852		.9930		1.4191		1.2797		1.2577
Second subperiod:																
Total.....	Grams.	5.4282	7.6092	9.4899	Grams.	10.0661	2.7271	1.4940	Grams.	6.2717	Grams.	6.5029	Grams.	8.0241	Grams.	48.1628
Average.....		1.0836	1.5218	1.8962		2.0132	.5454	.2988		1.2543		1.3126		1.6048		1.6054
Third subperiod:																
Total.....	Grams.	12.8208	3.8907	11.9408	Grams.	9.1770	10.3323	13.7241	Grams.	8.9273	Grams.	11.7991	Grams.	14.4002	Grams.	58.5367
Average.....		2.5642	.7721	2.3882		1.8354	2.0665	2.7448		1.7855		2.3598		2.8818		2.3060
Fourth subperiod:																
Total.....	Grams.	6.2411	2.2268	11.1761	Grams.	4.3150	5.9928	11.2412	Grams.	2.8880	Grams.	4.5661	Grams.	5.0713	Grams.	29.7594
Average.....		1.2482	.4454	2.2352		.8630	1.1986	2.2482		.5776		.9132		1.0143		1.1904
Entire preservative period:																
Total.....	Grams.	31.1926	19.2073	38.6329	Grams.	29.8286	23.9468	33.3851	Grams.	20.1673	Grams.	30.0234	Grams.	33.9029	Grams.	168.0270
Average.....		1.5596	.9603	1.9316		1.4914	1.1973	1.6693		1.3445		1.5012		1.6951		1.4611
After period.																
First subperiod:																
Total.....	Grams.	4.8083	2.6280	3.0761	Grams.	4.3741	2.3518	4.2866	Grams.	4.1775	Grams.	4.7888	Grams.	5.3519	Grams.	23.9091
Average.....		.9617	.5256	.6152		.8748	.4704	.8573		.8355		.9578		1.0704		.7970
Second subperiod:																
Total.....	Grams.	7.8936	4.2260	4.7721	Grams.	2.7019	2.8439	4.3441	Grams.	4.0663	Grams.	3.9863	Grams.	7.0359	Grams.	27.4216
Average.....		1.5727	.8442	.9544		.5404	.5688	.8688		.9603		.7973		1.4072		.9141
Entire after period:																
Total.....	Grams.	12.6719	6.8480	7.8482	Grams.	7.0760	5.1957	8.6307	Grams.	8.7238	Grams.	8.7751	Grams.	12.3878	Grams.	48.0090
Average.....		.6316	.6849	.7848		.7076	.5196	.8631		.8724		.8775		1.2388		.8012

a No. 9 omitted in summary.

TABLE III.—*Excretion of the benzoic acid in the urine, Series VIII—Continued.*

## 3. TOTAL HIPPURIC AND BENZOIC ACIDS CALCULATED TO BENZOIC ACID.

Period.	Individual data.												Summaries.	
	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.	No. 9.	No. 10.	No. 11.	No. 12.	Nos. 1 to 6.	Nos. 7 to 12. <sup>a</sup>
<i>Fore period.</i>														
First subperiod:														
Total.....	Grams. 1.4671	Grams. 2.0628	Grams. 1.9281	Grams. 2.7336	Grams. 1.5920	Grams. 1.3763	Grams. 1.3797	Grams. 4.1800	Grams. 2.0635	Grams. 2.9304	Grams. 2.1804	Grams. 2.9337	Grams. 11.1369	Grams. 15.6077
Average.....	.2634	.4126	.3856	.5467	.3184	.2753	.2759	.8360	.4007	.5861	.4361	.5867	.3720	.5203
Second subperiod:														
Total.....	1.2343	2.1811	1.0685	1.4886	.8798	.9075	1.7519	2.1320	5.9631	1.3227	1.5874	3.7771	7.7598	16.5329
Average.....	.2469	.4362	.2137	.2977	.1760	.1815	.3504	.4264	1.1926	.2645	.3172	.7554	.2587	.5511
Entire fore period:														
Total.....	2.7014	4.2439	2.9966	4.2222	2.4718	2.2838	3.1316	6.3120	7.9666	4.2531	3.7665	6.7108	18.9197	32.1406
Average.....	.2701	.4244	.2997	.4222	.2472	.2284	.3132	.6312	.7967	.4253	.3767	.6711	.3154	.3357
<i>Preservative period.</i>														
First subperiod:														
Total.....	4.0308	6.0244	4.5526	4.5688	4.2209	4.7412	3.6837	7.3505	3.6822	5.5097	5.0976	5.2048	28.1387	30.5085
Average.....	.8062	1.2049	.9105	.9138	.8442	.9482	.7367	1.4701	.7324	1.1019	1.0195	1.0410	.9380	1.0170
Second subperiod:														
Total.....	6.0011	8.4172	7.2947	8.0152	7.3175	8.3231	5.9404	9.3018	4.7443	5.0986	6.9974	6.2180	45.3688	38.3005
Average.....	1.2002	1.6834	1.4589	1.6030	1.4635	1.6646	1.1881	1.8604	.9489	1.0197	1.3995	1.2436	1.5123	1.2767
Third subperiod:														
Total.....	7.9639	11.4167	2.8173	8.5206	7.0512	6.2552	7.8712	10.1441	8.2664	7.3373	8.5730	10.7243	43.9669	52.9163
Average.....	1.5812	2.2833	.5635	1.7041	1.4102	1.2510	1.5742	2.0288	1.6533	1.4675	1.7146	2.1449	1.4656	1.7639
Fourth subperiod:														
Total.....	7.9081	4.9837	1.9337	8.0451	3.0194	3.2029	4.6579	11.6358	.....	2.1942	3.2688	3.6886	29.0629	25.4253
Average.....	1.5816	.9907	.3867	1.6090	.6039	.6406	.9316	2.3272	.....	.4388	.6538	.7337	.9608	1.0170
Entire preservative period:														
Total.....	25.8459	30.8420	16.5983	29.1497	21.6900	22.5224	22.1532	38.4322	16.6729	20.1398	23.9368	25.8157	146.5673	147.1506
Average.....	1.2923	1.5421	.8299	1.4575	1.0805	1.1261	1.1076	1.9216	1.1115	1.0070	1.1968	1.2908	1.2214	1.2796
<i>After period.</i>														
First subperiod:														
Total.....	1.7330	3.6258	1.9358	2.3025	2.3018	3.0361	1.6443	3.4821	3.1259	2.0124	3.3634	3.6479	14.9350	17.2760
Average.....	.3466	.7252	.3872	.4605	.4604	.6072	.3289	.6964	.6252	.4025	.6727	.7296	.4978	.5759
Second subperiod:														
Total.....	2.7449	5.9961	3.4908	3.2186	3.1834	2.2561	2.0192	3.3539	3.0988	2.8002	2.7171	6.7203	20.8919	20.7495
Average.....	.5494	1.1992	.6982	.6437	.6397	.4512	.4038	.6968	.6198	.5720	.5434	1.3441	.6964	.6917

[illegible]

a No. 9 omitted in summary.



TABLE IV.—*Excretion of benzoic acid—supplemental study.*  
1. HIPPURIC ACID.

Period and sample.	Direct weighing of residue.						Titration with $\frac{N}{10}$ NaOH.						Direct weighing.		Titration.	
	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	Nos. 1, 2, and 3, a, 5, and 6, b, 2.	Nos. 4, 5, and 6, a, 5, and 6, b.	Nos. 1, 2, and 3, a, 5, and 6, b.	Nos. 4, 5, and 6, a, 5, and 6, b.
<i>Fore period, November 26-30, 1907.</i>																
Daily samples:																
Total.....	6.5830	5.8356	4.6646	5.7880	4.1309	4.1309										
Average.....	1.3166	1.1671	.9329	1.1576	.8262	.8262										
Composited samples:																
Total.....	6.1000	5.7820	3.6090	5.2440	8.1330	4.5540	5.1015	4.5099	2.8730	3.8986	6.1397	3.6480	15.4910	17.9310	12.5444	13.6863
Average.....	1.2200	1.1564	.7218	1.0488	1.6266	.9108	1.0203	.9150	.5746	.7797	1.2279	.7296	1.0361	1.1954	.8365	.9124
<i>Preservative period, December 1-10.</i>																
First subperiod, December 1-5:																
Daily samples—																
Total.....	15.4512	13.8701	10.7576	11.9356	13.4129	10.1457										
Average.....	3.0902	2.7740	2.1515	2.3871	2.6826	2.0291										
Composited samples—																
Total.....	10.6500	8.9310	6.8960	2.6640	4.8730	3.9530	8.8916	8.0138	6.2346	2.4756	4.4607	4.2459	26.4770	11.4900	23.1400	11.1822
Average.....	2.1300	1.7862	1.3792	.5328	.9746	.7906	1.7783	1.6028	1.2469	1.4951	.8921	.8492	1.7651	.7660	1.5427	.7455
Second subperiod, December 6-10:																
Daily samples—																
Total.....	17.3096	13.8840	11.7610	11.1269	14.7376	11.0287	15.6054	12.4076	9.8824	9.3945	12.8880	9.7365	42.9546	36.8872	37.8954	32.0190
Average.....	3.4619	2.7768	2.3522	2.2242	2.9475	2.2057	3.1211	2.4815	1.9765	1.8789	2.5796	1.9473	2.8636	2.4525	2.5264	2.1346
Composited samples—																
Total.....	14.5570	15.2320	12.2350	10.0670	14.2080	9.3680	12.7137	13.4501	11.2018	8.5759	12.8225	8.4219	42.0240	33.6420	37.3656	29.8203
Average.....	2.9114	3.0464	2.4470	2.0134	2.8416	1.8736	2.5427	2.6900	2.2404	1.7152	2.5645	1.6844	2.8016	2.2428	2.4910	1.9880
Entire preservative period:																
Daily samples—																
Total.....	32.7608	27.7541	22.5186	23.0565	28.1505	21.1744										
Average.....	3.2761	2.7754	2.2519	2.3057	2.8151	2.1174										
Composited samples—																
Total.....	25.2070	24.1630	19.1310	12.7310	19.0810	13.3210	21.6353	21.4639	17.4364	11.0515	17.2832	12.0678	68.5010	45.1330	60.5056	41.0025
Average.....	2.5207	2.4163	1.9131	1.2731	1.9081	1.3321	2.1605	2.1464	1.7436	1.1052	1.7283	1.2068	2.2833	1.5026	2.0169	1.3334
<i>After period, December 11-24.</i>																
First subperiod, December 11-15:																
Daily samples—																
Total.....	8.6160	6.7525	4.8793	6.6514	6.0632	5.2569	6.7622	5.2181	3.4367	4.9982	5.1790	3.8119	20.2478	18.5717	15.4170	13.8001
Average.....	1.7232	1.3505	.9759	1.3303	1.2126	1.0514	1.3524	1.0436	.6873	.9998	1.0358	.7624	1.3498	1.2381	1.0278	.9200



Composited samples—																
Total.....	7,4290	6,2750	3,7850	4,3020	5,5880	3,0110	5,9876	4,9261	2,8080	3,1738	4,2638	3,0591	17,4890	13,8010	13,7217	10,4066
Average.....	1,4840	1,2550	7,5740	8,6040	1,1176	7,8222	1,1975	9,8622	5,6616	6,3447	8,5538	6,1118	1,1660	9,0001	9,148	6,9988
Second subperiod, December 16-20:																
Daily samples—																
Total.....	5,5488	5,4269	3,4992	5,2960	6,8401	5,8735	3,3355	4,5585	2,0905	4,1629	4,9480	4,3120	14,4749	18,0066	9,9855	13,4220
Average.....	1,1098	1,0894	6,9998	1,0592	1,3680	1,1747	6,6711	9,1119	4,181	8,3246	9,9896	8,624	9,650	1,2006	6,657	8,8949
Composited samples—																
Total.....	3,9340	6,0660	5,0330	5,3530	6,6954	5,2960	3,1074	5,4702	3,6820	4,0168	5,5907	4,1058	15,5730	17,3440	12,2596	13,7133
Average.....	7,868	1,3212	1,0066	1,0706	1,3391	1,0592	6,215	1,0940	7,364	8,034	1,1181	8,211	1,0382	1,1563	8,173	9,142
Third subperiod, December 20-24:																
Daily samples—																
Total.....	4,3325	3,5803	3,1086	2,7469	1,9524	3,5139	3,3400	2,7016	1,9392	1,7341	6,0948	1,7589	11,2214	8,2132	7,9808	4,1882
Average.....	1,1321	8,951	7,772	6,867	3,881	8,7855	8,350	6,715	4,848	4,335	1,737	4,397	8,015	8,867	5,701	5,2920
Composited samples—																
Total.....	3,0640	3,3210	1,8540	1,7460	4,2370	1,4080	2,6027	2,8461	1,2978	1,4080	3,5943	8,801	8,2390	7,3910	6,7466	5,8884
Average.....	6,128	6,642	3,708	3,492	8,174	2,816	5,205	5,692	2,596	2,816	7,189	1,772	5,493	4,927	4,098	3,926
Entire after period:																
Daily samples—																
Total.....	18,6973	15,7597	11,4871	14,6943	15,4557	14,0443	13,4377	12,4792	7,4664	10,8952	10,8218	9,8828	45,9441	44,7945	33,3833	31,5980
Average.....	1,3364	1,1256	8,205	1,0496	1,1040	1,0462	9,598	8,914	5,333	7,781	7,730	7,059	1,0939	1,0666	8,089	7,523
Composited samples—																
Total.....	14,4270	16,2020	10,6720	11,4010	16,5204	10,6150	11,6977	13,2424	7,7878	8,5985	13,4488	8,0510	41,3010	38,5364	32,7279	30,0983
Average.....	1,0305	1,1573	7,623	8,144	1,1800	7,582	8,355	9,9459	5,563	6,142	9,606	5,751	9,834	9,175	7,792	7,166
Excess in preservative period over fore period—daily samples																
Average per man.....	19,5948	16,1371	13,1896	11,7275	16,5745	12,9124							16,3072	13,7381		
Excess in preservative period over fore period—composite samples																
Average per man.....	13,0070	12,5990	11,9130	2,2430	2,8150	4,2130	11,4023	12,3139	11,6904	3,2545	5,0042	5,3718	12,5063	3,0903	11,8022	4,5435

*b* Received benzoate of soda.

Received benzoic acid

TABLE IV.—*Excretion of benzoic acid—supplemental study—Continued.*  
2. BENZOIC ACID.

Period and sample.	Petroleum ether extract.						Total hippuric acid calculated to benzoic acid.						Hippuric acid as benzoic acid.	
	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	Nos. 1, 2, and 3 <i>a</i> .	Nos. 4, 5, and 6 <i>b</i> .
<i>Fore period, November 26-30, 1907.</i>														
Daily samples:														
Total.....	Grams. 0.3946	Grams. 0.0840	Grams. 0.4638	Grams. 0.2026	Grams. 0.3915	Grams. 0.2419	Grams. 4.4570	Grams. 3.2381	Grams. 3.1794	Grams. 4.2424	Grams. 4.0751	Grams. 2.8156	Grams. 10.8745	Grams. 11.1331
Average.....	.0789	.0168	.0927	.0405	.0783	.0484	.8914	.6476	.6359	.8185	.8150	.5631	.7250	.7422
Composited samples:														
Total.....	1730	.2100	.0160	.0570	.2000	.0480	4.1578	3.9410	2.4599	3.5743	5.5435	3.1040	10.5587	12.2218
Average.....	.0316	.0432	.0032	.0114	.0412	.0096	.8316	.7882	.4920	.7149	1.1087	.6208	.7039	.8118
<i>Preservative period, December 1-10.</i>														
First subperiod, December 1-5:														
Daily samples—														
Total.....	.2325	.2989	.1378	.1829	.2029	.1576	10.5328	9.5538	7.3325	8.1352	9.1412	6.9154	27.4191	23.1873
Average.....	.0465	.0598	.0276	.0366	.0406	.0315	2.1066	1.9108	1.4665	1.6270	1.8283	1.3831	1.8280	1.5458
Composited samples—														
Total.....	1230	1480	6680	2,4350	3,3190	2,0080	7,2590	6,0874	4,7003	1,8138	3,3214	2,6944	18,0472	7,8266
Average.....	.0246	.0296	.0198	.4870	.6640	.4136	1.4518	1.4175	.9401	.3628	.6643	.5389	1.2632	.5220
Second subperiod, December 6-10:														
Daily samples—														
Total.....	1405	1419	1524	4916	2249	.0674	11,7983	9,4634	8,0161	7,5802	9,9452	7,5172	29,2778	24,7771
Average.....	.0281	.0284	.0305	.0983	.0450	.0135	2.3596	1.8927	1.6082	1.5161	1.9890	1.5033	1.9518	1.6518
Composited samples—														
Total.....	1,1670	.2310	.2350	.2390	.3490	.2250	9,9221	10,3821	8,3394	6,8617	9,6842	6,3852	28,6436	22,9311
Average.....	.2334	.0462	.0470	.0478	.0698	.0450	1.9844	2.0764	1.6679	1.3605	1.9368	1.2770	1.9096	1.5287
Entire preservative period:														
Daily samples—														
Total.....	.3725	.4303	.2903	.6745	.4278	.2243	22,3311	18,9177	15,3486	15,7154	19,0804	14,4326	56,5974	49,2344
Average.....	.0373	.0430	.0290	.0675	.0428	.0224	2.2331	1.8918	1.5349	1.5715	1.9086	1.4433	1.8866	1.6411
Composited samples—														
Total.....	1,2900	.3790	.3340	2,6740	3,6680	2,3230	17,1811	16,4695	13,0397	8,6755	13,0056	9,0796	46,6908	22,5894
Average.....	.1290	.0379	.0334	.2674	.3668	.2323	1.7181	1.6470	1.3040	.8676	1.3066	.9080	1.5563	.7529
<i>After period, December 11-24.</i>														
First subperiod, December 11-15:														
Daily samples—														
Total.....	.1018	.0816	.0685	.0793	.1087	.0855	5,8726	4,6025	3,3257	4,5297	4,5416	3,5831	13,8008	12,6544
Average.....	.0204	.0163	.0137	.0159	.0217	.0171	1.1745	.9205	.6651	.9059	.9083	.7166	.9200	.8436

<b>Composited samples—</b>						
Total.....	.1190	.3450	.2550	.3310	.1460	.1920
Average.....	.0238	.0690	.0510	.0662	.0280	.0384
<b>Second subperiod, December 16-20:</b>						
Daily samples—						
Total.....	.1542	.0948	.1053	.0621	.1614	.1026
Average.....	.0308	.0190	.0211	.0124	.0323	.0205
(Composited) samples—						
Total.....	.1780	.0440	.0790	.1830	.4310	.2480
Average.....	.0356	.0088	.0158	.0366	.0860	.0490
<b>Third subperiod, December 21-24:</b>						
Daily samples—						
Total.....	.1480	.0653	.0640	.1580	.0527	.1431
Average.....	.0372	.0163	.0165	.0397	.0132	.0358
(Composited) samples—						
Total.....	.1020	.2820	.0320	.0110	.0830	.0390
Average.....	.0258	.0765	.0130	.0028	.0208	.0148
<b>Entire after period:</b>						
Daily samples—						
Total.....	.4040	.2417	.2398	.3003	.3228	.3312
Average.....	.0289	.0169	.0168	.0215	.0231	.0237
(Composited) samples—						
Total.....	.4450	.4543	.4000	.0729	.6540	.4890
Average.....	.0319	.0325	.0288	.0178	.0467	.0356
<b>Excess excreted in preservative period over fore period:</b>						
Daily samples.....						
Percentage excreted.....						
(Composited) samples.....						
Percentage excreted.....						
<b>Foal excreted in preservative period and first after-subperiod over the foregoing:</b>						
Daily samples.....						
Percentage excreted.....						
<b>Excess excreted in preservative and first and second after subperiods over foregoing:</b>						
Daily samples.....						
Percentage excreted.....						

a Received benzole acid,

*b* Received benzoate of soda.



## DAILY MEDICAL AND CLINICAL NOTES.

## INDIVIDUAL DATA.

*No. 1.—C. W. N.*

At the opening of the fore period No. 1 was normal: recorded temperature 98.4° F., pulse 72 beats per minute, weight 70.45 kilograms. This normal condition continued throughout the first fore subperiod with very little variation in temperature and pulse, the recorded temperature for the last day being 98.2° F., pulse 66, weight 71.4 kilograms. The average body weight for No. 1 for this first subperiod was 71.02 kilograms.

He was also normal throughout the second fore subperiod, the average body weight being 70.51 kilograms, and that for the entire fore period, 70.77 kilograms.

This subject had no illness during the relaxation period and all the vital functions, including heart action, were in normal condition. The clinical examination of the urine during the fore period for No. 1 showed nothing abnormal, no albumin, no casts, the kidneys performing their natural functions properly.

No. 1 started the first preservative subperiod with a temperature of 98.4° F., pulse 72, and weight 70.5 kilograms. This condition prevailed throughout the period with only slight deviations in temperature and pulse, and no symptoms of any nature were recorded. The average weight for this period was 70.21 kilograms.

The same normal conditions prevailed until the last day of the second preservative subperiod when the recorded temperature was 98.8° F., slightly higher than the previous average. The pulse was 84, and the weight 70 kilograms, the average weight for this subperiod being 70.3 kilograms.

On the first day of the third preservative subperiod the subject's temperature had fallen to normal and his weight was somewhat lower, 69.2 kilograms. This condition prevailed throughout this subperiod, and evidently the slight rise in temperature and pulse on the last day of the previous subperiod had no special significance. The average body weight for this period was 69.18 kilograms.

No. 1 continued in the same normal condition throughout the whole fourth preservative subperiod except that he complained of being hungry for several days and claimed that he had not had enough to eat from the beginning of the experiment, although the ration which was allowed him amounted to 4,000 calories a day, with a very wide choice of food. In fact, all of the members of this series were allowed considerable liberty in selecting their ration, with somewhat more variation during the first fore subperiod than in Series VII on sulphurous acid. The average body weight for the

fourth preservative subperiod was 69.32 kilograms, and that for the entire preservative period, 69.75 kilograms. There were no symptoms during the preservative period which the subject thought worthy to be recorded at the time; but he mentioned on several different occasions that, although he did not suffer from acute pains, he noticed a gradual decline in strength and a general physical weakness, so that at times he was scarcely able to attend to his work. The kidneys remained normal during this period, no abnormal constituents from a clinical point of view being found in the urine.

The after period for No. 1 is characterized by a remarkable constancy both in temperature and pulse, the temperature throughout being 98.4° F. and the pulse 66 beats. The average body weight for the first after subperiod was 69.33 kilograms, for the second subperiod, 69.41 kilograms, and for the entire after period, 69.37 kilograms. The feeling of hunger still persisted somewhat during this after period, and the subject complained that he felt excessively hungry during the entire period of observation.

There is nothing in the data as recorded by No. 1 which would indicate very alarming symptoms produced by the administration of the preservative with the exception, as stated, of the general depressed feeling and weakness which was evidenced during the time that the greatest amount of the preservative (2.5 grams per day) was given. The body weight showed a slight decrease throughout.

*No. 2.—W. P.*

The recorded temperature for No. 2 for the first fore subperiod was 98° F., pulse 61 beats, and weight 70.53 kilograms. He remained in a normal condition throughout this subperiod with only slight variations from these figures, the average body weight being 70.57 kilograms.

In the second fore subperiod the recorded temperature on the first day was 98° F., pulse 67 beats, and weight 70.43 kilograms. No abnormal conditions were reported during this subperiod, but on the last two days there was a slight depression in the temperature, 97.8° F. being recorded; the pulse, however, was normal, 66 beats, and the weight 70.65 kilograms. The average body weight for the second fore subperiod was 70.46 kilograms, and that for the entire fore period, 70.51 kilograms. No. 2 experienced some difficulty in selecting his ration and complained several times of not relishing his food and of loss of appetite. His general appearance was somewhat below normal and he evidently was not in first-class condition.

At the beginning of the preservative period No. 2's temperature was 98° F., pulse 68 beats, and weight 70.45 kilograms. He complained of sour stomach, of pains in the stomach, and a slight headache on this day, probably the result of his condition during the



fore period from which he had not yet recovered. Except for these complaints, registered on the first day, no symptoms were recorded during the first subperiod, and his condition remained practically the same. The average body weight for this period was 70.35 kilograms.

On the first day of the second preservative subperiod the temperature for No. 2 was 98° F., pulse 71 beats, weight 70.28 kilograms. On the third day No. 2 complained of a burning sensation in the stomach; the recorded temperature, pulse, and weight, however, are practically the same as on the first day of this subperiod. No. 2 had a slight headache on the next day and on the last day complained of a sour stomach which persisted during the entire afternoon. His temperature for the last day was 98.4° F., pulse 69 beats, and weight 70 kilograms. The average body weight for the second subperiod was 70.21 kilograms.

On the first day of the third preservative subperiod his temperature was 98° F., pulse 67 beats, and weight 70.05 kilograms. The subject was feeling normal but on the second day there was a recurrence of the sour stomach and the headache, with a slight rise in temperature and quickened pulse. The weight remained practically the same. On the fourth day his temperature registered 97.8° F., pulse 60 beats, and weight 70 kilograms. He complained of being sick at the stomach, of headache, and of a general weariness. The nauseated feeling persisted the following day, accompanied by headache and some loss of appetite. The recorded temperature on the last day was 98.1° F., pulse 68 beats, and weight 69.81 kilograms. The average body weight for this subperiod was 70.08 kilograms.

No. 2 had a temperature of 98.9° F. on the first day of the fourth preservative subperiod, pulse 76 beats, weight 69.21 kilograms. He complained of a burning sensation and pains in the stomach, and also of headache and a nauseated feeling continuing from the day before. The preservative was withdrawn after the first day of this subperiod. On the second day No. 2's temperature registered 98° F., pulse 66 beats, and weight 69.42 kilograms. He still complained of being sick at the stomach and of a headache. The temperature and pulse remained the same for the rest of the period, with a very slight variation in body weight. The feeling of weakness continued throughout the subperiod and the appetite remained poor, but the headache gradually disappeared. The recorded temperature on the last day was 98° F., pulse 72 beats, and weight 69.75 kilograms. No. 2 reported that he was feeling well on this day. The average body weight for the fourth preservative subperiod was 69.58 kilograms, and for the entire preservative period, 70.06 kilograms.

The first after subperiod was characterized by a gradual increase in temperature, reaching normal on the third day of the period and

then falling to 98° F. on the fourth day, and again being normal on the last day. The pulse on an average was 68 beats per minute. The appetite improved, and on the second and third days of this period No. 2 reported himself as being very hungry. On the fourth day there was a slight feeling of nausea which disappeared on the following day. The average body weight for this subperiod was 69.47 kilograms.

During the second after subperiod No. 2's temperature remained practically constant at 98° F., the pulse averaging 69 beats. He complained on the second and third days of having a bad taste in his mouth and a somewhat impaired appetite. The average body weight for this subperiod was 69.28 kilograms, and for the entire after period 69.37 kilograms.

As is seen, there was a gradual decline in weight throughout the period of observation. The characteristic symptoms for No. 2 were headache accompanied by a burning sensation in the stomach, which, as the preservative was increased, produced nausea.

*No. 3.—W. F. H.*

No. 3 began the fore period with a temperature of 99.1° F., pulse 90 beats, and body weight 64.3 kilograms. This high temperature and pulse must have been due to some irrelevant circumstance, as on the succeeding days of this subperiod his temperature and pulse were normal, and on the last day the recorded temperature was 98.4° F., pulse 72 beats, and weight 64.35 kilograms. The average body weight for the first fore subperiod was 64.13 kilograms. All the body functions of No. 3 were in normal condition, as was shown by the clinical examination.

In the second fore subperiod the subject reported himself in good condition the entire time. His heart action was normal and he had had no sickness during the relaxation period.

On the first and second days of the first preservative subperiod the recorded temperature was 99° F. and 99.3° F., and the pulse 85 and 78 beats, respectively. On the third and fourth days the temperature and pulse were normal, while on the last day the recorded temperature was 99° F., pulse 84 beats, and weight 64.45 kilograms. The average weight for this subperiod was 64.64 kilograms.

The temperature on the first day of the second preservative subperiod was normal, but the subject reported that he had passed a restless night. No other symptoms were recorded until the last day of this subperiod when he reported that he had a burning sensation in the esophagus and pit of the stomach which persisted all day. His temperature showed a gradual increase until the last day when it was recorded as 100° F., the pulse as 90 beats, and the weight as 64.4 kilograms. The average body weight for this subperiod was 64.62

kilograms, which was practically the same as the weight for the first preservative subperiod.

During the third preservative subperiod the high temperature still continued, 100.2° F. being registered on the first day, pulse 94 beats, body weight 63.75 kilograms. No. 3 complained of having a headache, indigestion accompanied by severe heartburn, and of tiring easily, also of poor appetite. He was unable to eat his full ration at dinner on this day, and the administration of the preservative was discontinued. The high temperature continued throughout the rest of the period. The same symptoms, that is, pains in the stomach, a feeling of weakness or faintness accompanied by nausea, headache and dizziness, and burning sensations in the throat and esophagus, were manifest on the next two days, diminishing somewhat on the last day; but the subject still complained of a slight touch of indigestion.

On the first three days of the fourth preservative subperiod the temperature was somewhat high, the pulse gradually approaching normal. The average weight for the period was 63.58 kilograms, which shows a slight gain over the weight of the third preservative subperiod. The average body weight for the entire preservative period was 64.04 kilograms, a loss of nearly 0.2 kilogram as compared with that of the fore period.

On the first day of the after period No. 3 complained of a slight headache, a feeling of dizziness, and a disagreeable sensation in the stomach. His temperature was 98.4° F., pulse 74 beats, and body weight 63.8 kilograms. No abnormal conditions obtained during the remainder of this subperiod. The body weight showed a slight increase, the average for the first after subperiod being 63.95 kilograms.

Normal temperature and pulse were recorded throughout the five days of the second after subperiod. The only symptom which persisted up to this time was the bad taste in the mouth. On the first day No. 3 reported that he was hungry. The average body weight for the subperiod was 63.58 kilograms, while that for the entire after period was 63.77 kilograms, still showing a gradual loss of weight, which is nearly 0.3 kilogram less than the average of the preservative period.

*No. 4.—G. W. H.*

No. 4 of this series, who replaced the original No. 4 of Series VII, began the fore period with all bodily functions in normal condition. He never had had any serious illness, his family history was good, his heart action normal, and all other body functions apparently discharged in a perfectly healthy manner. The temperature and pulse were normal throughout with the exception of the first day, when the temperature was slightly higher. The body weight on the last day of



the subperiod was 58.52 kilograms, the average for the entire subperiod being 58.89 kilograms.

This same normal condition prevailed during the first and second days of the second fore subperiod, but on the third day a temperature of 99.2° F. was recorded. There evidently existed a slightly febrile condition at this time, as the temperature on the following day was slightly above normal. The temperature and pulse for the last day were 98.6° F., and 90, respectively, and the body weight was 57.6 kilograms. The average body weight for this period was 57.92 kilograms, that for the entire fore period being 58.41 kilograms. The clinical examination of the urine for No. 4 during the fore period showed nothing abnormal, the kidneys performing their function properly.

The temperature and pulse were normal during the first preservative subperiod with the exception of the first and last days, when a slightly higher temperature was recorded. The body weight for the last day was 58.05 kilograms. The average body weight for the entire subperiod was 58.02 kilograms. No. 4 reported himself throughout the subperiod as feeling in good condition.

There were no striking symptoms during the second preservative subperiod in the case of No. 4, although a recurrence of the high temperature on two days of the period, preceded and followed in each case by a normal condition, was noted. There was a complaint, however, on the second day of a slightly uncomfortable feeling in the stomach which disappeared during the succeeding days of the subperiod. The average body weight for this subperiod was 58.26 kilograms.

At the beginning of the third preservative subperiod, No. 4's temperature was 99° F., pulse 78 beats, and weight 57.8 kilograms. He reported during the afternoon of the first day that he suffered from an acute pain, accompanied by a burning sensation in the stomach, which continued, however, only for a few hours in the afternoon. The temperature for the next day was still somewhat high, 98.8° F. being recorded, pulse 72 beats, and body weight 58.35 kilograms. The temperature and pulse for the remainder of the period were normal, and the body weight on the last day was 58.3 kilograms. There had been no recurrence of the symptoms he experienced on the first day, and the average body weight for this subperiod was 58.17 kilograms.

On the first day of the fourth preservative subperiod No. 4 reported that he had acute pains in the stomach and evidently experienced some indigestion. His appetite, however, was not impaired. The recorded temperature for this day was 99° F., pulse 72 beats, and weight 58 kilograms. This high temperature continued on the next day, pulse and weight being practically the same. On the third day he reported a sour stomach and a dull headache which persisted from the dinner of the preceding day throughout this day. The same



symptoms continued on the following day, and on the last day of the period he suffered from pains in the stomach, a constant dull headache, and a loss of appetite. The temperature and pulse for this day were 99.2° F., and 78 beats, respectively, while his weight was 58.15 kilograms. The average body weight for this subperiod was 58.1 kilograms, that for the entire preservative period being 58.14 kilograms, showing a loss of 0.27 kilogram from the average weight of the fore period.

On the first day of the after period the pain in the stomach persisted and the recorded temperature and pulse were 98.8° F., and 72 beats, respectively. The only abnormal symptom for the remainder of the first subperiod was a slightly increased temperature which persisted until the last day, when it returned to normal, 98.6° F. The weight for this day was 58.1 kilograms, and the average body weight for the subperiod, 58.22 kilograms.

The second after subperiod was characterized by a slightly increased temperature, the pulse a little above normal, and the average body weight, 58.11 kilograms. The body weight for the entire after period averaged 58.17 kilograms, being practically the same as that of the preservative period. There were no symptoms whatever during this last after subperiod.

The characteristic symptoms for this subject during the preservative period were pains in the abdominal region, a dull headache, some loss of appetite, slight indigestion, and, as was reported during the time of observation, a general feeling of weakness which was so marked as almost to incapacitate him at times for his work.

*No. 5.—C. P.*

This subject passed through the relaxation period without any sickness. The heart action and all the other vital functions were normal. No. 5 began the first fore subperiod with a temperature 98.4° F., pulse 90 beats, body weight 51.43 kilograms. All bodily-functions at the beginning of this series were normal. The clinical examination of the urine showed it to be normal, and the subject passed through the relaxation period without any disturbance worthy of mention. This condition continued throughout the first fore subperiod, on the last day of which his temperature was 98.6° F., pulse 82 beats, and weight 51.24 kilograms. The average body weight for this subperiod was 51.56 kilograms.

The same normal condition prevailed throughout the second fore subperiod, the temperature remaining quite uniform and the pulse showing very slight fluctuations from day to day. The average body weight for this subperiod was 51.23 kilograms, and for the entire fore period 51.39 kilograms.

At the beginning of the first preservative subperiod the temperature and pulse of No. 5 were  $98.4^{\circ}$  F., and 80 beats, respectively, while the body weight was 51.44 kilograms. He was normal on the second day, but on the third day reported a slight headache in the afternoon; no increase of either temperature or pulse, however, was noted. The headache continued during the following day accompanied by a slight burning in the stomach and the throat for a few minutes after breakfast. No increase in either temperature or pulse, however, was recorded. On the last day the temperature was normal, pulse 88 beats, and body weight 51 kilograms. No symptoms of any kind were reported on this day and the subject stated that he felt well. The average body weight for this subperiod was 51.08 kilograms.

The recorded temperature for No. 5 on the first day of the second preservative subperiod was  $98.6^{\circ}$  F., pulse 88 beats, and body weight 51 kilograms. He complained during the day of a burning sensation in the throat and had felt very badly during the night. On the next day he had symptoms which indicated slight indigestion. These disappeared, however, on the following day, and a small increase both in temperature and pulse was noted. His condition was normal on the fourth day, but on the last day of the subperiod the symptoms of indigestion recurred. His temperature and pulse, however, were normal, and the body weight was 50.8 kilograms, the average weight for the subperiod being 50.97 kilograms.

No. 5 reported that he felt well at the beginning of the third preservative subperiod. On the next day, however, a slight rise in temperature and pulse was noted, and he complained of severe pains in the stomach during the night, accompanied by headache and a general feeling of malaise. A very decided increase in appetite was noted which was not satisfied at meal times. On the following day his pulse and temperature still remained somewhat higher than normal and he experienced sharp pains in the head. After breakfast he was suddenly taken with nausea and vomiting. The temperature for the next day was normal. The subject, however, reported that he had a slight headache and felt generally miserable, the feeling of intense hunger continuing. The next day his temperature was still normal, the pulse slightly increased, and the feeling of hunger persisted together with the general feeling of malaise. The average body weight for this subperiod was 50.59 kilograms, a loss of nearly 0.4 kilogram, as compared with the preceding subperiod.

The recorded temperature and pulse at the beginning of the fourth preservative subperiod were  $98.6^{\circ}$  F., and 86 beats per minute, respectively, with a body weight of 50.4 kilograms. The subject reported himself as feeling well but very hungry. On the following day a slight rise in temperature was noted. No. 5 reported that after

meals he had a decidedly nauseated sensation for a few hours. Fearing a recurrence of the nausea and vomiting, the preservative was withdrawn at this point. On the following day his temperature and pulse were normal but the subject still complained of a feeling of hunger and pains in the side. On the last two days there were no symptoms recorded and the temperature and pulse continued normal. The body weight on the last day was 50.25 kilograms, that for the fourth subperiod 50.28 kilograms—again a loss of a little over 0.3 kilogram as compared with the preceding subperiod—and that for the entire preservative period, 50.73 kilograms—nearly 0.7 kilogram less than the average weight of the fore period.

In the first after subperiod the temperature and pulse were normal throughout, but a few symptoms, such as hunger and pain in the back, were noted on three different occasions. The average body weight for this subperiod was 50.33 kilograms.

On the first two days of the second after subperiod No. 5 still had a feeling of hunger; the temperature and pulse, however, remained normal throughout. The body weight on the last day of this subperiod was 50.63 kilograms, temperature and pulse  $98.4^{\circ}$  F., and 86 beats, respectively. The average body weight was 50.56 kilograms, showing a slight gain over that of the first after subperiod. The average weight for the entire after period was 50.45 kilograms.

The characteristic symptoms developed by this subject during the observation, as noted, are a burning sensation in the esophagus and alimentary canal, headache, and later, as the preservative was increased, a nauseated feeling which came on suddenly and on one day resulted in vomiting. The preservative was diminished on this occasion, but when it was again increased the nausea returned and the preservative was withdrawn entirely. The subject complained of a feeling of hunger from this time on until well into the after period.

*No. 6.—L. M. S.*

No. 6 entered the period of observation in good condition, having had no illness during the relaxation period, and his heart action was normal. The recorded temperature and pulse for the first day of the fore period were  $98.5^{\circ}$  F., and 79, respectively, with a body weight of 59.9 kilograms. The subject remained normal throughout the first subperiod, at the end of which he weighed 59.4 kilograms. The average weight for the subperiod was 59.6 kilograms.

During the second fore subperiod the subject remained in good condition; his temperature on the last day was  $98.3^{\circ}$  F., pulse 72 beats, body weight 59 kilograms. The body weight for this subperiod averaged 59.26 kilograms, and for the entire fore period, 59.43 kilograms.



In the first preservative subperiod the recorded temperature and pulse for the first day were 98.7° F., and 94 beats, respectively, the body weight being 59.34 kilograms. A slight rise in temperature was noted on the second day, the pulse dropping back to normal, and the subject reported that he had a slight attack of indigestion and headache in the morning. The same temperature and pulse were recorded on the following day, the dull headache continuing. On the fourth day the subject's temperature and pulse were 99° F., and 84 beats, respectively, and a slight attack of indigestion was noted. The temperature on the last day of this subperiod was 98.8° F., pulse 78 beats, and body weight 59 kilograms. He complained of a dry, irritated feeling in the throat. The average body weight for the first subperiod was 59.24 kilograms, practically the same as the average weight for the preceding subperiod.

On the first day of the second preservative subperiod No. 6 had a temperature of 99° F., pulse 79 beats, and body weight 59.1 kilograms. He complained of sore throat and his tongue was slightly coated. Temperature and pulse were high on the second day of this subperiod, being 99° F., and 90 beats, respectively, and the dry and irritated feeling in the throat continued. On the next day, however, the temperature and pulse were normal but he still complained of a slight irritation in the throat. High temperature and pulse were recorded on the following day but no other symptoms worthy of notice were mentioned. The temperature and pulse were normal on the last day of the second subperiod, but the subject complained of having a slight headache accompanied by ringing in the ears. The body weight for this day was 58.9 kilograms and the average for the subperiod was 59.11 kilograms, a very slight loss as compared with the first subperiod.

At the opening of the third preservative subperiod the temperature was 99.8° F., pulse 78 beats, and body weight 58.94 kilograms. A slight headache was recorded which continued during the next day accompanied by ringing in the ears, pains in the stomach, and loss of appetite. Although temperature was normal, the pulse was exceedingly high, registering 98 beats. The temperature and pulse were normal on the third day, but the ringing in the ears continued on this and the following day though the temperature and pulse remained normal. On the last day of the subperiod No. 6 complained of severe headache, ringing in the ears, and pronounced pains in the stomach. Later in the evening he became nauseated and vomited a slight amount. The recorded temperature and pulse for this day were 98.5° F., and 79 beats, respectively, and the body weight 58.5 kilograms. The average body weight for this subperiod was 58.56 kilograms, 0.55 kilogram less than the average weight of the second preservative subperiod.



In the fourth subperiod no preservative was administered. On the first day the subject's temperature was 99° F., pulse 79, and body weight 58.55 kilograms. He complained of headache, nausea, and a touch of indigestion, also a dry, parched feeling in the throat. His temperature and pulse were normal on the following day, but a loss of appetite was reported; otherwise he felt very well. The normal temperature and pulse continued throughout the remainder of this subperiod, the subject feeling well with the exception of a loss of appetite. The body weight on the last day was 58.25 kilograms, while for the subperiod it averaged 58.4 kilograms, and for the entire preservative period 58.83 kilograms, showing a decrease of 0.6 kilogram from the average of the fore period.

The first day of the after period a temperature of 98.6° F., pulse 78 beats, and body weight 58.55 kilograms were recorded. The subject complained of a dry, parched feeling in his throat which, however, was not noted on the succeeding days when temperature and pulse, also, remained normal. The body weight on the last day was 58.4 kilograms and the average for the subperiod 58.47 kilograms, practically the same as that for the last preservative subperiod.

No. 6 was under observation only three days in the second after subperiod. His temperature and pulse were normal with no symptoms of any kind, the subject recording that he felt in good condition. The average weight for this subperiod was 58.44 kilograms and that for the entire after period 58.46 kilograms.

The characteristic symptoms developed by No. 6 during the period in which the preservative was administered were headache, ringing in the ears, slight indigestion, irritated feeling in the throat and esophagus, and nausea.

*No. 7.—J. N. B.*

This subject was the least accurate of all the members of this series, and his recorded observations were subjected to the closest scrutiny. He had a very vivid imagination and the least excitement developed almost any symptoms which his fancy might dictate. At the beginning of the fore period the temperature was 98.1° F., pulse 84 beats, and the body weight 70.1 kilograms. He was in excellent physical condition and had entirely recovered from the supposed effects recorded in Series VII. He had a uniformly low temperature throughout this subperiod, pulse normal, and body weight 70.15 kilograms on the last day. The average body weight for the subperiod was 70.16 kilograms.

The temperature continued subnormal during the second fore subperiod but the pulse was normal. The body weight on the last day of this period was 70 kilograms, the average for the subperiod 70.02 kilograms, and that for the entire fore period 70.09 kilograms.

At the beginning of the preservative period No. 7 had a temperature of 98.3° F., pulse 72, and body weight 69.65 kilograms, the temperature and pulse remaining normal throughout the first subperiod. The recorded weight for the last day was 69.5 kilograms, the average for the entire subperiod being 69.8 kilograms.

The continued subnormal temperature was noted at the beginning of the second preservative subperiod, pulse normal, and body weight 69.9 kilograms. Temperature and pulse were normal on the third day, but the subject complained of drowsiness. A touch of indigestion was noted on the next day; temperature and pulse, however, continued normal. No symptoms were recorded on the last day, the subject closing the second subperiod with a temperature of 98.7° F., pulse 78 beats, and body weight 69.8 kilograms. The average body weight for this subperiod was 69.84 kilograms, a slight increase as compared with the average weight of the first preservative subperiod.

In the third preservative subperiod the temperature and pulse showed a slight variation, but not enough to be considered abnormal. Slight indigestion and a feeling of nervousness are reported but no other symptoms worthy of note during the remainder of the subperiod. The body weight on the last day was 69.4 kilograms and the average weight for the subperiod 69.49 kilograms.

The recorded temperature for No. 7 on the first day of the fourth preservative subperiod was 98.4° F., pulse 78 beats, body weight 68.9 kilograms. Temperature and pulse were normal on the second day, but the subject reported that he was taken sick immediately after luncheon. On the following day the recorded temperature was slightly subnormal, the pulse 90 beats, and body weight 69.45 kilograms. There was a decided loss of appetite which continued during the following two days, accompanied on the last day by general lassitude. Temperature and pulse were normal during this time and the recorded body weight for the last day was 69.05 kilograms, the average weight for the last subperiod being 69.28 kilograms and that for the entire preservative period 69.6 kilograms, showing a loss of nearly 0.5 kilogram as compared with the average weight of the fore period. No preservative was given No. 7 after he developed nausea.

The temperature and pulse for this subject were normal throughout the first after subperiod and the body weight on the last day was 69.25 kilograms. No symptoms of any nature were recorded with the exception of a possible feeling of malaise on the third day. The average body weight for this subperiod was 69.36 kilograms.

The temperature during the second after subperiod was somewhat subnormal throughout, pulse normal, and body weight on the last day 69.05 kilograms. There were no symptoms of any nature

recorded and the subject had regained his normal condition. The average body weight for the last subperiod was 69.17 kilograms, practically the same weight as was recorded for the last preservative subperiod, but there is a decrease of 0.33 kilogram comparing the averages for the entire preservative and after periods.

*No. 8.—W. C. L.*

This subject was by far the most regular in his habits and paid the strictest attention to detail of all the members of the table. As is mentioned in the medical data for Series VII (Part III of Bulletin 84), he had certain idiosyncracies which would make a study of his metabolic processes somewhat different from that of the other members. He regularly took a prescribed laxative throughout this experiment and drank large quantities of water during the day, as well as at meal times. He had a very vivid imagination and some of the symptoms which he noted were entirely irrelevant, requiring considerable analysis before credit could be given them.

He entered the fore period with a temperature of 98.4° F., pulse 68 beats, and a body weight of 61.65 kilograms. His temperature was slightly subnormal on two days during the subperiod, pulse normal throughout, and recorded body weight 61.42 kilograms on the last day. He had suffered no sickness of any nature during the relaxation period and entered the experiment in excellent condition. His average weight for this subperiod was 61.59 kilograms.

He was normal throughout the second fore subperiod with the exception of a slight headache on the last day, probably due to excitement caused by an examination which he had undergone the day before. His average weight for the second fore subperiod was 61.08 kilograms and that for the entire fore period 61.33 kilograms.

No. 8 entered the preservative period with a temperature of 98.5° F., pulse 67, and body weight 60.9 kilograms. His temperature throughout the first subperiod was slightly subnormal, pulse normal with some variation, and body weight on the last day 60.5 kilograms. No symptoms of any nature were recorded that had any bearing on the work. The average weight for this subperiod was 60.74 kilograms.

On the first day of the second preservative subperiod the temperature of No. 8 was 98.3° F., pulse 57, and body weight 60.8 kilograms. He complained on this day of a slight feeling of indigestion and looseness of bowels. On the following day he drank a large quantity of water and these symptoms disappeared; his temperature and pulse were normal. On the third day his temperature was slightly subnormal and the pulse normal, but complaint was made of an uncomfortable feeling in the stomach. Temperature and pulse on the following day were normal, the pain in the stomach, however, continuing during



the night and the last day of the subperiod when the temperature recorded was 98.3° F., pulse 60, and body weight 60.8 kilograms. The average weight for this subperiod was 60.91 kilograms, a slight increase as compared with the preceding one.

On the first day of the third preservative subperiod the temperature and pulse recorded were normal and the body weight 60.2 kilograms. The subject complained of a restless night and a slight pain in the stomach which still continued in the morning. The temperature and pulse on the fourth day were normal and the pain in the stomach previously noted had disappeared, but he experienced a slightly nauseated feeling in the afternoon and did not relish his meals. However, later in the day, he developed a feeling of hunger. His temperature on the last day of this subperiod was slightly subnormal, pulse normal, and body weight 60.4 kilograms. He complained of a slight headache after luncheon and developed quite a strong nauseated feeling after dinner. His average weight for the subperiod was 60.36 kilograms, a loss of 0.55 kilogram as compared with that of the second subperiod.

On the first day of the fourth preservative subperiod the subject's temperature and pulse were 98.4° F., and 65 beats, respectively, and the body weight 59.8 kilograms. He reported that he had not slept well the previous night and had a slight headache during the day, with some pain in the stomach. The following day he again complained of a slight headache during the afternoon and a feeling of weakness. A slight pain in the stomach was also noted just before dinner on this day. His temperature for the third day of this subperiod was 98.8° F., with pulse normal, but he still complained of a slight headache and weakness. Although his rations seemed a little large at this time, he experienced no difficulty in eating them. A feeling of drowsiness was noted during the afternoon of each day of this subperiod. On the fourth day his temperature and pulse were normal, although a slight headache and a marked feeling of weakness were noted. Also a feeling of hunger developed in the afternoon which was accompanied at intervals by slight nausea. The recorded temperature for the last day of the subperiod was 98° F., pulse 62, body weight 60.5 kilograms. The subject reported that he felt very weak during this and the previous day. His average weight for this subperiod was 60.14 kilograms, a decrease of 0.22 kilogram from the average of the preceding subperiod. The average weight for the entire preservative period was 60.54 kilograms, representing a loss of 0.8 kilogram as compared with the fore period.

An analysis and summary of the symptoms developed by No. 8 during this period show that he suffered with headache, slight pains in the stomach at various times, a marked feeling of weakness, and slight nausea which was noticeable several times during the last pre-



servative subperiod, in which the highest amount of preservative was given, namely, 2.5 grams per day. This record accords with the symptoms noted by Nos. 1 and 4, who developed the same feeling of weakness when this amount of preservative was given. It might be well to mention here that No. 8, although physically the weakest member of the class, had in this observation as well as in Series VI and VII taken the entire amount of preservative during the whole series. Although he developed the same symptoms as the other members of the class, his general appearance at the end of each observation was by far better than that of any other member who took the same amount of preservative, or even less. This may well be ascribed, as was suggested before, to the large amount of water which he drank, and this should be taken into consideration in studying the data for this subject.

The temperature for No. 8 at the beginning of the after period was quite subnormal, pulse normal, and body weight 60.05 kilograms. He reported a slight improvement in his condition over that of the previous day, but was still weak. The same condition prevailed on the second day, the subject reporting that he felt quite weak, but otherwise in good condition. The weakness and malaise continued on the third day, the temperature and pulse, however, being normal. The temperature and pulse continued normal on the following day, the subject reporting that he felt considerably better. On the last day of this subperiod the temperature for No. 8 was 98.7° F., pulse 75 beats, body weight 59.3 kilograms. The subject reported that he slept poorly during the night and awoke with a headache, but felt fairly well during the day. He also reported a slight headache and nausea immediately after dinner, and the symptoms of a slight cold. The average weight for this first subperiod was 59.93 kilograms, which shows a slight loss as compared with the last preservative subperiod, and a decrease of 0.61 kilogram from the average of the entire preservative period.

On the first day of the second after subperiod the temperature was normal, pulse slightly above normal, and body weight 59.45 kilograms. The subject reported that he felt very well. On the following day the temperature and pulse were normal, but he complained of having had a slight headache during the previous night and forenoon. Temperature and pulse were normal on the last three days of this subperiod and the subject reported himself as feeling all right.

*No. 9.—G. W. L.*

No. 9 passed through the relaxation period without trouble of any sort and was in excellent condition at the beginning of the fore period.

In the first fore subperiod the temperature and pulse were normal throughout, and the body weight on the last day was 62.1 kilograms, the average for the entire subperiod being 61.79 kilograms.

His temperature was normal throughout the second fore subperiod, pulse slightly higher than in the previous subperiod, registering 81 beats. The body weight for the last day was 61.85 kilograms, the average for this subperiod being 61.78 kilograms, which was practically the same as that for the first subperiod, giving an average of 61.79 kilograms for the entire fore period.

There were no changes from this normal condition throughout the first preservative subperiod, the temperature remaining practically constant at 98.4° F., pulse 81 beats. The subperiod closed with the subject weighing 62 kilograms, the average weight for the five days being 61.81 kilograms.

There was no deviation from this normal condition throughout the second preservative subperiod with the exception of a slight rise in temperature on the second day. The body weight on the last day was 61.82 kilograms, the average weight for the subperiod being 61.77 kilograms.

On the first day of the third preservative subperiod No. 9's temperature registered 98.6° F., pulse 82 beats, and body weight 61.65 kilograms. The same normal condition prevailed on the second day, but on the following day a temperature of 99° F. was noted, pulse 82 beats, and the subject complained of having a very sore and inflamed throat and of being somewhat constipated. On the following day the temperature was still 99° F., pulse 82 beats, and the subject complained that he felt sick, having pains in the stomach and bowels, and a sore throat. Later, after dinner on that day, he became nauseated and vomited part of the meal. On the last day of the third subperiod his temperature registered 99.1° F., pulse 83 beats, and body weight 61.7 kilograms. He complained of feeling very weak and of soreness in the region of the stomach. The administration of the preservative was discontinued after this day. The average body weight for this subperiod was 61.73 kilograms.

No. 9 was ill and remained in his room on the first day of the fourth preservative subperiod. On the next day he reported that he felt somewhat better but had no appetite and complained of soreness in the region of the stomach. His temperature was 99.4° F., pulse 84 beats. On the third day his temperature was still high, registering 99.4° F., and pulse 82 beats, but continued improvement was reported. His temperature on the following day was 98.8° F., pulse 82 beats, and he was gradually regaining his normal condition although he still had a feeling of soreness in the stomach and the bowels. The temperature on the last day of this subperiod had again risen to 99.1° F., pulse 81 beats, body weight 61.5 kilograms, and the subject reported that he was again feeling all right. The body weight for this subperiod, which includes the last three days

only, averaged 61.27 kilograms. The average body weight for the entire preservative period was 61.77 kilograms.

All of the analytical data for No. 9 during the fourth preservative subperiod were discarded as he was ill on the first day and was allowed to eat other food than the prescribed ration.

On the first day of the after period No. 9's temperature registered 98.4° F., pulse 82 beats, and body weight 61.3 kilograms. He reported himself in good condition throughout the first after subperiod. His pulse and temperature were normal and his body weight on the last day was 61.4 kilograms. The average body weight for this subperiod was 61.39 kilograms.

Normal conditions prevailed throughout the second after subperiod, temperature and pulse were normal, and No. 9 reported that he was in fine condition in every way. The body weight on the last day was 61.5 kilograms, and the average for this subperiod 61.46 kilograms. The average body weight for the entire after period was 61.43 kilograms.

The characteristic symptoms for No. 9 were burning sensations in the alimentary canal, but this subject did not pay the strictest attention to these details and may not have recorded them all. He had one attack of nausea with vomiting which was noted after dinner on May 4, and another attack after breakfast on May 6. He did not complain of being nauseated at any other time, and these attacks apparently came on suddenly.

*No. 10.—R. D. B.*

No. 10 entered the period of observation in first-class condition. He had had no illness during the relaxation period and all of his bodily functions were normal. He continued normal throughout the first fore subperiod, the body weight on the last day being 57.4 kilograms, and the average weight for the subperiod 56.73 kilograms.

He was normal throughout the second fore subperiod with only a slight deviation from time to time in pulse and temperature, the body weight for the last day being 56.45 kilograms and the average for the subperiod 56.49 kilograms. The average weight for the entire fore period was 56.61 kilograms.

On the first day of the preservative period No. 10's temperature and pulse registered 98.2° F., and 80 beats, respectively, and the body weight 56.4 kilograms. His temperature for the remainder of the first subperiod was normal with only slight variations from day to day, the pulse, however, showing a wide range each day. On the second and fourth days 102 and 120 beats, respectively, were recorded. This can hardly be attributed to any influence of the preservative, the only plausible explanation being that No. 10, who had to walk a considerable distance from the medical school in which he was a



student, had hurried and was not allowed sufficient time to rest before taking the pulse. His body weight on the last day was 56.6 kilograms, the average for the first preservative subperiod being 56.41 kilograms.

On the first day of the second preservative subperiod the subject's recorded temperature was  $98.6^{\circ}$  F., pulse 86 beats, and body weight 56.65 kilograms. Temperature and pulse were normal throughout this subperiod, but on the fourth day No. 10 complained of cramps in the stomach which continued during the following day accompanied by headache. His body weight on this day was 56.5 kilograms, pulse 94 beats, temperature normal. The average weight for the second subperiod was 56.53 kilograms.

On the first day of the third preservative subperiod the temperature and pulse were normal and the body weight 56.6 kilograms. The subject still suffered from cramps in the stomach. On the following day his temperature registered  $98.8^{\circ}$  F., and pulse 82 beats. There was a slight increase in temperature noted on the third day,  $99^{\circ}$  F. being recorded, and pulse 108 beats. He complained upon this day of having pains in the stomach with a return of headache in the frontal region. On the following day his temperature was somewhat subnormal, pulse slightly above normal, and he complained of having a sweet, sickening taste in his mouth and pains in the stomach. The same conditions existed upon the last day of this subperiod, when his temperature registered  $98.9^{\circ}$  F., his pulse 88 beats, and his body weight 56 kilograms. The average body weight for the third subperiod was 56.26 kilograms. The subject's appetite had been growing less during the last few days until on the morning of the fifth day of this subperiod he ate very little breakfast. No preservative was given on this day, yet he was suddenly taken sick during the night with cramps, followed by vomiting.

No. 10 did not receive the preservative during the fourth preservative subperiod which he entered with a temperature of  $98.9^{\circ}$  F., pulse 80 beats, and a body weight of 55 kilograms. He complained of a severe pain in the frontal region of the head and a pain in the stomach during this first day. The headache continued on the second day, the subject's temperature registering  $98.5^{\circ}$  F., and his pulse 70. His temperature and pulse were normal on the third day, but he again suffered from cramps and had an attack of nausea and vomiting after breakfast. He was feeling well on the last two days of this subperiod, pulse normal and temperature somewhat subnormal. The body weight for the last day was 55.65 kilograms and the average for the subperiod 55.30 kilograms, which is a loss of nearly a kilogram as compared with the average weight of the third preservative subperiod. The average for the entire preservative period was 56.13



kilograms, which is a decrease of nearly half a kilogram from the average of the fore period.

During the first after subperiod No. 10 reported that he was feeling well. His temperature still registered subnormal throughout the period, pulse normal, and his body weight for the last day was 57.05 kilograms. The average weight for this subperiod was 56.6 kilograms.

The same gradual improvement was noted during the second after subperiod, the subject reporting that he was in good condition at the end of this time. The body weight on the last day was 56.82 kilograms, the average weight for the subperiod being 57.08 kilograms and that for the entire after period 56.84 kilograms—0.71 kilogram more than the average for the preservative period.

The characteristic symptoms for this subject during the preservative period were cramps and pains in the stomach and in the frontal region of the head. He also was nauseated to such an extent that he vomited on two different occasions. This feeling, as in the case of No. 9, came on very suddenly. In addition to these symptoms, No. 10 also had a sweetish, disagreeable taste in his mouth for several days during the period.

*No. 11.—A. F. M.*

No. 11 entered the fore period in excellent condition. He was normal in every particular and had no sickness during the period of relaxation. On the first day his temperature and pulse were 98.2° F., and 66 beats, respectively, and his body weight 68.18 kilograms. He was normal during the remainder of the first fore subperiod, the body weight for the last day being 68.3 kilograms and the average for the subperiod 68.12 kilograms.

The same normal condition prevailed throughout the five days of the second fore subperiod, the body weight on the last day being 67.6 kilograms. The weight for this subperiod averaged 67.95 kilograms, and for the entire fore period 68.03 kilograms.

No. 11 had a temperature of 98.2° F. and pulse 66 on the first day of the preservative period and weighed 67.54 kilograms. He had a normal temperature and pulse until the fourth day when the temperature rose to 99.2° F., and the pulse to 72 beats. He noted in his "Remarks" that he was suffering from a slight cold. His temperature was 99.3° F. on the following or last day of the subperiod, pulse 84 beats, and body weight 67.61 kilograms. He noted that he had a dry, parched feeling in his throat, which in his case was probably due to the cold which still persisted. His average weight for this subperiod was 67.64 kilograms.

On the first day of the second preservative subperiod No. 11's temperature registered 98.2° F., pulse 72 beats, and weight 67.4 kilograms. He reported that his cold was better, but the dry sensation

in his throat still remained. Temperature and pulse were normal on the second and third days of this subperiod, but a slight headache was noted on the third and fourth days. The temperature and pulse on the fourth day were normal, but on the last day the temperature rose to 98.9° F., and the pulse to 80 beats, while the body weight was 67.1 kilograms. The subject reported that he had a feeling of weakness in his stomach and was somewhat feverish. The average body weight for the second subperiod was 67.28 kilograms.

No. 11's temperature and pulse were 98.7° F., and 72 beats, respectively, on the first day of the third preservative subperiod; his body weight was 67.14 kilograms. He recorded that he had a general feeling of weakness, and on the following day his temperature rose to 99° F., and his pulse to 75 beats. On this day he also suffered from a slight headache which continued during the third day. The temperature and pulse, however, were normal and remained so on the next day, though the slight headache still persisted. His temperature registered 98.8° F., pulse 69 beats, and body weight 67.08 kilograms on the last day of this subperiod, for which the average body weight was 67.13 kilograms.

On the first day of the fourth preservative subperiod No. 11 had a temperature of 99.4° F., pulse 66 beats, and a body weight of 67.04 kilograms. He complained of feeling very weak and of having nausea after dinner. The administration of the preservative was stopped at this time. The following day his temperature and pulse were normal, but he complained of a weak and uncomfortable feeling in his stomach. On the third day the pulse and temperature were normal, the subject was feeling fairly well and had no abnormal symptoms. His temperature showed a slight increase on the fourth day, but his pulse was normal and he felt well. On the last day he was normal and had no distressing symptoms. The body weight on this day was 67.51 kilograms, and the average for the last subperiod 67.13 kilograms, the same as in the previous subperiod. The average weight for the entire preservative period was 67.29 kilograms.

No. 11 was normal throughout the first after subperiod with the exception of his temperature on the third day which reached 99° F., and his pulse which rose to 81 beats. He reported, however, that he felt very well on this day and during the remainder of the subperiod. His body weight on the last day was 66.43 kilograms, the average weight for this subperiod being 66.63 kilograms.

On the first day of the second after subperiod No. 11's temperature and pulse were normal, and the body weight 66.15 kilograms. He became nauseated shortly after eating breakfast and vomited the entire meal. On the following day he felt well again but his temperature was slightly high, 98.8° F. His pulse, however, was normal, and there were no abnormal symptoms throughout the remainder of

this subperiod which he closed weighing 66.65 kilograms and feeling well. The average body weight for this subperiod was 66.34 kilograms, and that for the entire after period 66.49 kilograms, showing a gradual decrease throughout the period of observation.

The characteristic symptoms for No. 11 were slight inflammation in the throat, some headache, a weak and distressed feeling in the stomach, a general lassitude, and nausea which occurred even after the administration of the preservative had stopped.

*No. 12.—R. B. R.*

No. 12 had an attack of measles during the relaxation period and was confined to his bed one week and to his room for nearly two weeks. All symptoms of the disease had passed away at the opening of the period of observation and his physical condition had been restored to a perfect normal.

On the first day of the fore period his temperature was 98.4° F., pulse 74 beats, and weight 67.55 kilograms. His condition continued normal throughout this subperiod and when it closed his body weight was 67.7 kilograms, the average weight for the subperiod being 67.45 kilograms.

During the second fore subperiod the temperature and pulse continued normal with slight variations from day to day, the body weight for the last day being 67.7 kilograms and his average body weight 67.76 kilograms, thus making the average for the entire fore period 67.61 kilograms.

No. 12 entered the preservative period with a temperature of 98.2° F., pulse 76 beats, and body weight 67.95 kilograms. His appetite was noted as being very "keen." The temperature and pulse remained normal during the following days, and the subject reported that he felt all right. The body weight on the last day of the first subperiod was 67.85 kilograms and the average for the subperiod 68.01 kilograms.

On the first day of the second preservative subperiod the temperature and pulse were normal and the body weight 67.8 kilograms. The subject reported that he felt well and that his appetite was good. The following day a subnormal temperature was noted, the pulse remained normal, and the subject complained that he felt somewhat fatigued, but he still had a good appetite. He was normal again on the following three days and closed the second subperiod with a body weight of 68.3 kilograms, the average weight for the subperiod being 68.32 kilograms.

On the first day of the third preservative subperiod No. 12's temperature and pulse were 98.6° F., and 76 beats, respectively, his body weight being 68.4 kilograms. He reported that he had a heavy and depressed feeling in his stomach, and on the following day expe-



rienced a decided loss of appetite so that he did not eat his ration with the usual enjoyment. Moreover, he felt very tired, although he had not taken an undue amount of exercise. His temperature and pulse were normal and remained so on the following day, but the gradual loss of appetite continued. On the fourth day the subject's temperature and pulse were normal but he reported that he had a headache and did not rest well during the night, also that he had some pain in his stomach and felt generally uncomfortable. Temperature and pulse were normal on the last day of the third subperiod and the body weight 68.2 kilograms; but on the evening of this day No. 12 reported that he felt quite sick, having had a severe pain in his stomach all day accompanied by headache, and pains in the region of the kidneys. His average weight for the third subperiod, however, was 68.42 kilograms, showing a gradual increase.

In the fourth preservative subperiod No. 12 did not receive any preservative. His temperature and pulse were normal on the first day and the body weight 68.2 kilograms, but he complained of some pain in the stomach. On the following day he still showed a normal temperature and pulse, and reported that his appetite was returning but that he had experienced a sensation of weakness for a few hours during the morning. On the third day the temperature and pulse were normal, but a loss of appetite was noted. A "tired feeling," continuing throughout the fourth day, was reported and the subject said that he no longer relished his meals. The temperature and pulse were normal on the last day of this subperiod and the body weight was 68.3 kilograms. No. 12 reported that he felt very well during this day and that his appetite was somewhat improved. The average weight for this subperiod was 68.18 kilograms, that for the entire preservative period 68.23 kilograms, showing a gain of 0.62 kilogram as compared with the average of the fore period.

Throughout the first after subperiod, No. 12's temperature and pulse were normal with slight variations from day to day. He reported himself as feeling well, but on one occasion noted that his appetite was still somewhat below normal; otherwise, he was in good condition. The body weight on the last day was 68.3 kilograms, the average weight for this subperiod being 68.23 kilograms.

The temperature on the first four days of the second after subperiod was somewhat subnormal, pulse normal. On the second day the subject reported that he was nauseated, although he did not vomit, and felt weak. But on the following day he felt well again and closed the observation with a temperature of 98.4° F., pulse 74 beats, and a body weight of 68.25 kilograms. The weight for this subperiod averaged 68.1 kilograms and that for the entire after period 68.17 kilograms.



A summary of the symptoms of No. 12 shows a most striking loss of appetite, although his ration at the beginning was eaten with a relish. Headache, slight irritation and pains in the stomach, and a nauseated feeling on one occasion near the end of the after period are also recorded.

### CONCLUSIONS.

These data show that the preservatives in the quantities administered produced marked symptoms of discomfort and positive malaise in the majority of cases. The most common symptoms are nausea and headache, which occurred in nine and eight cases, respectively, the nausea producing vomiting in only three cases. Seven of the subjects complained of weakness and burning and irritating sensations in the esophagus. Symptoms of hunger and indigestion occurred in three and five cases, respectively. It is thus seen that there was a marked effect under the administration of the preservative to produce headache and nausea, accompanied by lassitude.

### BODY WEIGHTS.

#### VARIATIONS IN BODY WEIGHTS.

The data showing the variations in body weight are given in Table V, and in graphic form in figures 1 and 2.

The platted figures represent all the weight data irrespective of variations in administration of the preservative.

The data show a loss in the preservative period in nine cases and a gain in one case (No. 12). In only two cases, Nos. 4 and 10, is there any appreciable gain in the after period over the preservative period, and these gains are very slight. In the case of No. 1 the chart shows a very great loss of weight during the preservative period, and this loss is continued, though in a less degree, in the after period. No. 2 experienced a slight loss of weight during the preservative period and an increased loss during the after period. The chart of No. 3 shows a very slight loss of weight during the preservative period, followed by another slight loss of weight in the after period. The data for No. 4 show a slight loss of weight during the preservative period and a very slight gain during the after period. No. 5 suffered a marked loss of weight in the preservative period and a slight loss in the after period. No. 6 shows a notable loss of weight in the preservative period and almost as much in the after period. No. 7 experienced a considerable loss of weight in the preservative period and a slight loss in the after period. No. 8 shows a marked loss of weight in the preservative period and another loss equally great in the after period. No. 9 is probably the only member of the table whose weight is not perceptibly affected during the preservative period. There is, however,

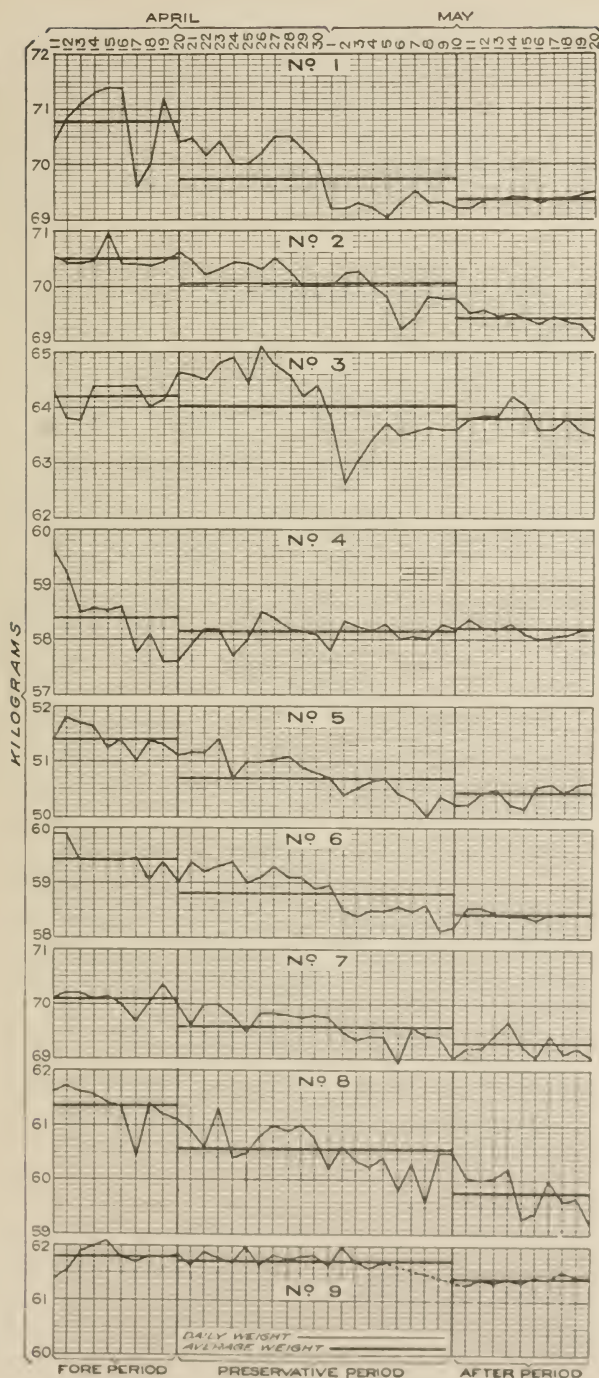


Fig. 1. Average body weights for Series VIII, Nos. 1 to 9,

a very slight loss of weight in the after period. No. 10 shows quite a loss of weight in the preservative period and a larger gain in the after period, so that his weight at the end of the observation is greater than at the beginning. No. 11 suffered a notable loss of weight in the preservative period and a still greater loss in the after period. No. 12 shows a marked gain in weight in the preservative period, and his weight during the after period remains the same as in the preservative period.

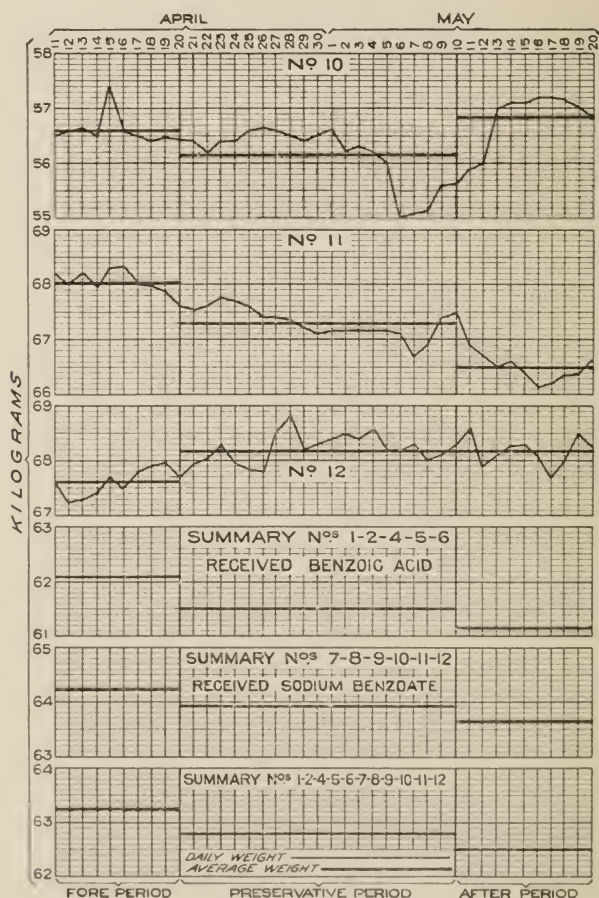


FIG. 2.—Average body weights for Series VIII, Nos. 10 to 12 and summaries.

The charts show a loss throughout the observation in nine cases and a gain in one case, while in two cases, Nos. 4 and 10, there is a loss in the preservative period and a gain in the after period.

Combining the data for Nos. 1, 2, 4, 5, and 6, who received benzoic acid, it is seen that the average loss of weight during the preservative period is about half a kilogram and the loss during the after period an additional 0.4 of a kilogram. The average weights of Nos. 7 to 12, who received sodium benzoate, show a loss of weight of



about 0.3 kilogram during the preservative period and an additional loss of about the same magnitude during the after period. The general effect upon the weight of the body appears to be more marked in the case of benzoic acid than in the case of sodium benzoate, though the effect is to decrease the weight in both cases. The general average, omitting No. 3 on account of imperfections in the observations, shows for the eleven men a notable loss of weight during the preservative period and an additional loss, of about the same magnitude, in the after period. The general conclusion, therefore, to be drawn from these observations is that the administration of benzoic acid as such or as sodium benzoate, in the quantities mentioned, tends to produce a condition of the system which causes a loss in the weight of the body; that is, the activities of a katabolic nature, destroying and excreting tissue, are greater than those of an anabolic nature, absorbing and building up tissue. This effect does not cease immediately upon the withdrawal of the preservative, but is continued in the majority of cases to a greater or less extent throughout the after period.

#### RATIO OF FOOD WEIGHT TO BODY WEIGHT.

In Table V are found the data relating to the quantity of food consumed by each individual and the ratio of the weight of the food consumed to the weight of the body. The average weight of No. 1 for the fore period is 70.77 kilograms and the average weight of the moist food consumed is 2,388 grams, equivalent to 606 grams of dry substance. The weight of the dry food consumed is 0.86 per cent of the body weight. In the preservative period there was a loss of weight of about 1 kilogram, the quantity of moist food consumed being slightly increased and that of dry food slightly decreased. The ratio of the weight of dry food to the body weight is practically the same as that of the fore period. In the after period there is a further loss of weight and a smaller quantity of dry food is consumed, amounting to 0.82 per cent of the weight of the body.

No. 2 weighs about the same as No. 1 but consumes a slightly larger quantity of food, the amount of dry food consumed in the fore period being 0.93 per cent of the body weight, in the preservative period 0.93 per cent, and in the after period 0.91 per cent. The quantity of dry food consumed remains almost constant during the three periods, being 659 grams in the fore period, 651 grams in the preservative period, and 634 grams in the after period. There was a progressive loss of weight during the experiment, decreasing from 70.51 kilograms in the fore period to 70.06 in the preservative period, and 69.37 kilograms in the after period.

No. 3 weighed notably less than Nos. 1 and 2 and ate, proportionately, a larger quantity of food, the amount of dry food consumed being 1.01 per cent of the body weight in the fore period, 0.96 per cent



in the preservative period, and 1.04 per cent in the after period. There was a progressive loss of weight during the observation. The quantity of dry food consumed was reasonably constant, though somewhat less in the preservative period, the quantities being 648 grams, 613 grams, and 666 grams for the three periods, respectively. There is a continued loss of weight in the after period, although the quantity of dry food was notably increased.

No. 4 was still lighter in weight than No. 3, but ate about the same quantity of food in proportion to the weight of his body as No. 2. The weight of dry food is 0.90, 0.88, and 0.89 per cent of the weight of the body for the three periods, respectively. The quantities of dry food eaten in the three periods are almost identical. There is a slight loss of weight noticed in the preservative period and a very slight gain over the preservative period in the after period.

No. 5 is a smaller man than any of the preceding subjects, weighing only 51.39 kilograms, but eats practically the same quantity of food in proportion to the weight of his body, the weight of the dry food being 0.94, 0.96, and 0.98 per cent of the weight of the body for the three periods, respectively. There is a progressive loss of weight during the observation. The quantity of dry food remains almost the same, though it is slightly greater in the preservative and after periods than in the fore period.

No. 6 weighs almost 60 kilograms at the beginning of the experiment and loses weight progressively throughout the period of observation. The weight of the dry food consumed is 0.97, 0.95, and 0.98 per cent of the weight of the body for the three periods, respectively.

In the case of No. 7, the weight of dry food is 0.74, 0.72, and 0.64 per cent of the body weight for the three periods. In this case there was again a progressive decrease in the weight of the body, and the quantity of dry food consumed also decreased, especially in the after period. The loss of weight, therefore, may be in this case justly attributed to the decrease in the quantity of food.

No. 8, although a much smaller subject, ate more food than No. 7, the percentage of dry food as compared with the body weight being 0.94, 0.94, and 0.96, respectively. In this case also there was a decrease in weight which can hardly be due to a decrease in the quantity of food, the amounts eaten being practically the same in the fore and after periods and only slightly less in the preservative period.

In the case of No. 9, the weight of the dry food is 0.84, 0.82, and 0.82 per cent of the body weight in the three periods, respectively. The body weight in the fore period is practically the same as in the preservative period, and there is a slight loss in the after period. The quantity of dry food consumed is slightly greater in the fore period than in the preservative or after period. Little effect is noticed on the part of the preservative to disturb the ratio in this case. The data for No. 10 show that he was the heartiest eater in proportion to

his weight of all the members of the table, with the exception perhaps of No. 12. The percentages are 1.03, 0.96, and 0.98, respectively. The quantity of dry food consumed is notably less in the preservative period, and somewhat less in the after period, than in the fore period. There is a slight loss of weight in the preservative period, which is more than regained in the after period, although the quantity of food consumed is not so great as in the fore period. There is, therefore, practically no effect produced in this case by the preservative on the relation between the weight of the body and the weight of the dry food consumed.

In the case of No. 11, the weight of dry food is 0.94, 0.95, and 0.96 per cent of the body weight in the three periods, respectively. The quantity of dry food consumed in the fore period and the preservative period is almost identical, while the quantity consumed in the after period is larger than in either. There is again a progressive loss of weight which is more marked in this case, since the quantity of food consumed is increased toward the end of the observations rather than diminished.

No. 12 is also a very hearty eater, as shown by the relation of body weight to the weight of the dry food consumed, this percentage being 1.02, 0.98, and 0.94, respectively. Slightly less food is consumed in the preservative period than in the fore period and much less in the after period, notwithstanding which there was a gain in weight in the preservative period and only a slight decrease in the after period, the final weight being higher than that of the fore period.

The data for Nos. 1 and 4 may be summarized for the entire period of observation. There is a progressive decrease in weight which can be accounted for only in a very small degree by the differences in food. There is 13 grams less food consumed daily in the preservative period than in the fore period, but the loss in weight is 640 grams. In the after period there is an additional loss of weight of 180 grams, only 10 grams of which can be ascribed to the decreased quantity of food. The variations in weight of dry food compared with body weight are expressed by 0.87, 0.86, and 0.85 per cent for the three periods, respectively.

A summary for Nos. 1, 2, 4, 5, and 6 is made for the whole of the fore period, for three of the preservative periods, and the whole of the after period. This also shows a progressive loss of weight with a very slight decrease in the amount of dry food consumed daily, amounting to 5 grams in the preservative period and 16 grams in the after period. The weights for dry foods are 0.92, 0.91, and 0.91 per cent of the body weight for the three periods, respectively.

A complete summary for Nos. 7 to 12, inclusive, is made for the entire observation period, with the exception of the fourth preservative subperiod. There is again shown a progressive loss of weight

attended by a very slight decrease in the daily food consumed of 8 grams in the preservative period and 25 grams in the after period. The ratios are 0.92, 0.91, and 0.88, respectively. They also show that the quantity of dry food consumed by the men composing this table is slightly less than 1 per cent of the weight of the body.

Omitting No. 3 (on account of incomplete data), a summary for all the members of the table may be made for the entire observation with the exception of the fourth preservative subperiod. This summary shows the progressive decrease in weight, amounting to about 0.75 kilogram if the averages for the fore and after periods be compared. The amount of dry food consumed daily is 7 grams less in the preservative period, and 21 grams less in the after period than in the fore period. The relations of food weight to body weight are expressed by 0.92, 0.91, and 0.89 per cent for the three periods, respectively.

TABLE V.—Amount of moist and dry food consumed, expressed as percentage of body weight, Series VIII.

[Averages are per day.]

Period.	No. 1.						No. 2.					
	Body weight.	Weight of food.		Average daily ratio of food weight to body weight.			Body weight.	Weight of food.		Average daily ratio of food weight to body weight.		
		Moist.	Dry.	Moist.	Dry.			Moist.	Dry.	Moist.	Dry.	
<i>Fore period.</i>												
First subperiod:	<i>Kilos.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>		<i>Kilos.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	
Total.....	355.10	11,815	2,980	3.33	0.84		352.85	16,354	3,255	4.63	0.92	
Average.....	71.02	2,363	596									
Second subperiod:												
Total.....	352.55	12,067	3,076	3.42	.87		70.57	3,271	651			
Average.....	70.51	2,413	615				352.28	16,153	3,335	4.59	.95	
							70.46	3,231	667			
Entire fore period:												
Total.....	707.65	23,882	6,056	3.37	.86		705.13	32,507	6,500	4.61	.93	
Average.....	70.77	2,388	606				70.51	3,251	659			
<i>Preservative period.</i>												
First subperiod:												
Total.....	351.05	12,316	2,957	3.51	.84		351.77	15,030	3,294	4.53	.94	
Average.....	70.21	2,463	591				70.35	3,188	659			
Second subperiod:												
Total.....	351.50	11,576	2,953	3.29	.84		351.05	16,983	3,250	4.84	.93	
Average.....	70.30	2,315	591				70.21	3,397	650			
Third subperiod:												
Total.....	345.90	12,109	2,908	3.50	.84		350.38	16,797	3,309	4.79	.94	
Average.....	69.18	2,422	582				70.08	3,359	662			
Fourth subperiod:												
Total.....	346.60	12,404	2,976	3.58	.86		347.92	17,757	3,165	5.10	.91	
Average.....	69.32	2,481	595				69.58	3,551	633			
Entire preservative period:												
Total.....	1,395.05	48,405	11,794	3.47	.85		1,401.12	67,476	13,018	4.82	.93	
Average.....	69.75	2,420	590				70.06	3,374	651			
<i>After period.</i>												
First subperiod:												
Total.....	346.65	11,321	2,860	3.27	.83		347.33	17,448	3,167	5.02	.91	
Average.....	69.33	2,264	572				69.47	3,490	633			
Second subperiod:												
Total.....	347.07	10,782	2,813	3.11	.81		346.41	15,731	3,168	4.54	.91	
Average.....	69.41	2,156	563				69.28	3,146	634			
Entire after period:												
Total.....	693.72	22,103	5,673	3.19	.82		693.74	33,179	6,335	4.78	.91	
Average.....	69.37	2,210	567				69.37	3,318	634			



TABLE V.—Amount of moist and dry food consumed, expressed as percentage of body weight, Series VIII—Continued.

[Averages are per day.]

Period.	No. 3.						No. 4.					
	Body weight.	Weight of food.		Average daily ratio of food weight to body weight.			Body weight.	Weight of food.		Average daily ratio of food weight to body weight.		
		Moist.	Dry.	Moist.	Dry.			Moist.	Dry.	Moist.	Dry.	
<i>Fore period.</i>												
First subperiod:	<i>Kilos.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>		<i>Kilos.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	
Total.....	320.65	13,808	3,225	4.31	1.01		294.47	11,151	2,654	3.79	0.90	
Average.....	64.13	2,762	645				58.89	2,230	531			
Second subperiod:												
Total.....	321.62	13,816	3,257	4.30	1.01		289.62	11,010	2,578	3.80	.89	
Average.....	64.32	2,763	651				57.92	2,202	516			
Entire fore period:												
Total.....	642.27	27,624	6,482	4.30	1.01		584.09	22,161	5,232	3.79	.90	
Average.....	64.23	2,762	648				58.41	2,216	523			
<i>Preservative period.</i>												
First subperiod:												
Total.....	323.20	13,821	3,300	4.28	1.02		290.10	12,130	2,610	4.18	.90	
Average.....	64.64	2,764	660				58.02	2,426	522			
Second subperiod:												
Total.....	323.10	15,269	3,301	4.73	1.02		291.31	10,885	2,569	3.74	.88	
Average.....	64.62	3,054	660				58.26	2,177	514			
Third subperiod:												
Total.....	316.60	12,899	2,483	4.07	.78		290.85	11,560	2,596	3.97	.89	
Average.....	63.32	2,580	497				58.17	2,312	519			
Fourth subperiod:												
Total.....	317.90	15,206	3,183	4.78	1.00		290.50	11,377	2,515	3.92	.87	
Average.....	63.58	3,041	637				58.10	2,275	503			
Entire preservative period:												
Total.....	1,280.80	57,195	12,267	4.47	.96		1,162.76	45,952	10,290	3.95	.88	
Average.....	64.04	2,860	613				58.14	2,298	514			
<i>After period.</i>												
First subperiod:												
Total.....	319.75	15,136	3,362	4.73	1.05		291.10	10,837	2,560	3.72	.88	
Average.....	63.95	3,027	672				58.22	2,167	512			
Second subperiod:												
Total.....	317.92	14,835	3,295	4.67	1.04		290.55	10,865	2,615	3.74	.90	
Average.....	63.58	2,967	659				58.11	2,173	523			
Entire after period:												
Total.....	637.67	29,971	6,657	4.70	1.04		581.65	21,702	5,175	3.73	.89	
Average.....	63.77	2,997	666				58.17	2,170	518			

TABLE V.—Amount of moist and dry food consumed, expressed as percentage of body weight, Series VIII—Continued.

[Averages are per day.]

Period.	No. 5.					No. 6.				
	Body weight.	Weight of food		Average daily ratio of food weight to body weight.		Body weight.	Weight of food.		Average daily ratio of food weight to body weight.	
		Moist.	Dry.	Moist.	Dry.		Moist.	Dry.	Moist.	Dry.
<i>Fore period.</i>										
First subperiod:	<i>Kilos.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Kilos.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>
Total.....	257.80	10,558	2,363	4.10	0.92	298.01	12,386	2,880	4.16	0.97
Average.....	51.56	2,112	473			59.60	2,477	576		
Second subperiod:										
Total.....	256.13	11,027	2,486	4.31	.97	296.32	13,776	2,888	4.65	.97
Average.....	51.23	2,205	497			59.26	2,755	578		
Entire fore period:										
Total.....	513.93	21,585	4,849	4.20	.94	594.33	26,162	5,768	4.40	.97
Average.....	51.39	2,159	485			59.43	2,616	577		
<i>Preservative period.</i>										
First subperiod:										
Total.....	255.39	10,493	2,451	4.11	.96	296.22	13,339	2,938	4.50	.99
Average.....	51.08	2,099	490			59.24	2,668	588		
Second subperiod:										
Total.....	254.86	11,424	2,505	4.48	.98	295.54	13,487	2,767	4.56	.94
Average.....	50.97	2,285	501			59.11	2,697	553		
Third subperiod:										
Total.....	252.93	11,518	2,435	4.55	.96	292.82	13,727	2,743	4.69	.94
Average.....	50.59	2,304	487			58.56	2,745	549		
Fourth subperiod:										
Total.....	251.39	11,004	2,397	4.38	.95	292.00	12,854	2,695	4.40	.92
Average.....	50.28	2,201	479			58.40	2,571	539		
Entire preservative period:										
Total.....	1,014.57	44,439	9,788	4.38	.96	1,176.58	53,407	11,143	4.54	.95
Average.....	50.73	2,222	489			58.83	2,670	557		
<i>After period.</i>										
First subperiod:										
Total.....	251.64	11,414	2,462	4.54	.98	292.36	12,648	2,769	4.33	.95
Average.....	50.33	2,283	492			58.47	2,530	554		
Second subperiod:										
Total.....	252.81	11,557	2,495	4.57	.99	292.21	12,336	2,814	4.22	.96
Average.....	50.56	2,311	499			58.44	2,467	563		
Entire after period:										
Total.....	504.45	22,971	4,957	4.55	.98	584.57	24,984	5,583	4.27	.96
Average.....	50.45	2,297	496			58.46	2,498	558		

a Daily average added in order to complete record.

TABLE V.—Amount of moist and dry food consumed, expressed as percentage of body weight, Series VIII—Continued.

[Averages are per day.]

Period.	No. 7.					No. 8.				
	Body weight.	Weight of food.		Average daily ratio of food weight to body weight.		Body weight.	Weight of food.		Average daily ratio of food weight to body weight.	
		Moist.	Dry.	Moist.	Dry.		Moist.	Dry.	Moist.	Dry.
<i>Fore period.</i>										
First subperiod:	<i>Kilos.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Kilos.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>
Total.....	350.81	10,848	2,530	3.09	0.72	307.93	16,091	2,843	5.23	0.92
Average.....	70.16	2,170	506			61.59	3,218	569		
Second subperiod:										
Total.....	350.10	10,965	2,672	3.13	.76	305.41	19,065	2,935	6.24	.96
Average.....	70.02	2,193	534			61.08	3,813	587		
Entire fore period:										
Total.....	700.91	21,813	5,202	3.11	.74	613.34	35,156	5,778	5.73	.94
Average.....	70.09	2,181	520			61.33	3,516	578		
<i>Preservative period.</i>										
First subperiod:										
Total.....	349.00	10,693	2,463	3.06	.71	303.70	16,457	2,933	5.42	.97
Average.....	69.80	2,139	493			60.74	3,291	587		
Second subperiod:										
Total.....	349.20	11,312	2,591	3.24	.74	304.55	18,056	2,820	5.93	.93
Average.....	69.84	2,262	518			60.91	3,611	564		
Third subperiod:										
Total.....	347.45	10,875	2,619	3.13	.75	301.80	16,788	2,840	5.56	.94
Average.....	69.49	2,175	524			60.36	3,358	568		
Fourth subperiod:										
Total.....	346.40	10,851	2,290	3.13	.66	300.70	16,279	2,806	5.41	.93
Average.....	69.28	2,170	458			60.14	3,256	561		
Entire preservative period:										
Total.....	1,392.05	43,731	9,963	3.14	.72	1,210.75	67,580	11,369	5.58	.94
Average.....	69.60	2,187	498			60.54	3,379	570		
<i>After period.</i>										
First subperiod:										
Total.....	346.80	11,072	2,387	3.19	.69	299.65	15,631	2,907	5.22	.97
Average.....	69.36	2,214	477			59.93	3,126	581		
Second subperiod:										
Total.....	345.85	8,829	2,075	2.55	.60	298.00	16,979	2,858	5.70	.96
Average.....	69.17	1,766	415			59.60	3,396	572		
Entire after period:										
Total.....	692.65	19,901	4,462	2.87	.64	597.65	32,610	5,765	5.46	.96
Average.....	69.27	1,990	446			59.77	3,261	576		



TABLE V.—Amount of moist and dry food consumed, expressed as percentage of body weight, Series VIII—Continued.

[Averages are per day.]

Period.	No. 9.					No. 10.				
	Body weight.	Weight of food.		Average daily ratio of food weight to body weight.		Body weight.	Weight of food.		Average daily ratio of food weight to body weight.	
		Moist.	Dry.	Moist.	Dry.		Moist.	Dry.	Moist.	Dry.
<i>Fore period.</i>										
First subperiod:	<i>Kilos.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Kilos.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>
Total.....	308.96	11,371	2,615	3.68	0.85	283.65	11,544	2,808	4.07	0.99
Average.....	61.79	2,274	523			56.73	2,309	562		
Second subperiod:										
Total.....	308.90	11,422	2,596	3.70	.84	282.45	12,196	3,018	4.32	1.07
Average.....	61.78	2,284	519			56.49	2,439	604		
Entire fore period:										
Total.....	617.86	22,793	5,211	3.69	.84	566.10	23,740	5,826	4.19	1.03
Average.....	61.79	2,279	521			56.61	2,374	583		
<i>Preservative period.</i>										
First subperiod:										
Total.....	309.04	11,828	2,566	3.83	.83	282.05	11,406	2,803	4.04	.99
Average.....	61.81	2,366	513			56.41	2,281	561		
Second subperiod:										
Total.....	308.85	11,473	2,536	3.71	.82	282.67	11,766	2,844	4.16	1.01
Average.....	61.77	2,295	507			56.53	2,353	569		
Third subperiod:										
Total.....	308.66	11,849	2,502	3.84	.81	281.30	11,359	2,647	4.04	.94
Average.....	61.73	2,370	500			56.26	2,272	529		
Fourth subperiod:										
Total.....						276.48	10,765	2,446	3.89	.88
Average.....						55.30	2,153	489		
First, second, and third subperiods:										
Total.....	926.55	35,150	7,604	3.79	.82					
Average.....	61.77	2,343	507							
Entire preservative period:										
Total.....						1,122.50	45,296	10,740	4.04	.96
Average.....						56.13	2,265	537		
<i>After period.</i>										
First subperiod:										
Total.....	306.95	12,084	2,547	3.94	.83	282.99	11,658	2,858	4.12	1.01
Average.....	61.39	2,417	509			56.60	2,332	572		
Second subperiod:										
Total.....	307.32	12,283	2,502	4.00	.81	285.42	11,382	2,717	3.99	.95
Average.....	61.46	2,457	500			57.08	2,276	543		
Entire after period:										
Total.....	614.27	24,367	5,049	3.97	.82	568.41	23,040	5,575	4.05	.98
Average.....	61.43	2,437	505			56.84	2,304	558		

TABLE V.—Amount of moist and dry food consumed, expressed as percentage of body weight, Series VIII—Continued.

[Averages are per day.]

Period.	No. 11.					No. 12.				
	Body weight.	Weight of food.		Average daily ratio of food weight to body weight.		Body weight.	Weight of food.		Average daily ratio of food weight to body weight.	
		Moist.	Dry.	Moist.	Dry.		Moist.	Dry.	Moist.	Dry.
<i>Fore period.</i>										
First subperiod:	<i>Kilos.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Kilos.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>
Total.....	340.61	15,501	3,092	4.55	0.91	337.25	13,492	3,382	4.00	1.00
Average.....	68.12	3,100	618			67.45	2,698	676		
Second subperiod:										
Total.....	339.73	15,206	3,295	4.48	.97	338.82	14,148	3,503	4.18	1.03
Average.....	67.95	3,041	659			67.76	2,830	701		
Entire fore period:										
Total.....	680.34	30,707	6,387	4.51	.94	676.07	27,640	6,885	4.09	1.02
Average.....	68.03	3,071	639			67.61	2,764	688		
<i>Preservative period.</i>										
First subperiod:										
Total.....	338.20	14,531	3,319	4.30	.98	340.05	14,674	3,486	4.32	1.03
Average.....	67.64	2,906	664			68.01	2,935	697		
Second subperiod:										
Total.....	336.40	15,269	3,201	4.54	.95	341.58	13,981	3,432	4.09	1.00
Average.....	67.28	3,054	640			68.32	2,796	686		
Third subperiod:										
Total.....	335.63	16,022	3,263	4.77	.97	342.10	14,430	3,329	4.22	.97
Average.....	67.13	3,204	653			68.42	2,886	666		
Fourth subperiod:										
Total.....	335.63	15,940	2,948	4.75	.88	340.90	14,069	3,104	4.13	.91
Average.....	67.13	3,188	590			68.18	2,814	621		
Entire preservative period:										
Total.....	1,345.86	61,762	12,731	4.59	.95	1,364.63	57,154	13,351	4.19	.98
Average.....	67.29	3,088	637			68.23	2,858	668		
<i>After period.</i>										
First subperiod:										
Total.....	333.14	15,357	3,305	4.61	.99	341.15	13,312	3,262	3.90	.96
Average.....	66.63	3,071	661			68.23	2,662	652		
Second subperiod:										
Total.....	331.71	14,286	3,226	4.31	.97	340.50	12,922	3,144	3.80	.92
Average.....	66.34	2,857	645			68.10	2,584	629		
Entire after period:										
Total.....	664.85	29,643	6,531	4.46	.98	681.65	26,234	6,406	3.85	.94
Average.....	66.49	2,964	653			68.17	2,623	641		

TABLE V.—Amount of moist and dry food consumed, expressed as percentage of body weight, Series VIII—Continued.

## SUMMARIES.

[Averages are per man per day.]

Period.	Nos. 1 and 4.					Nos. 1, 2, 4, 5, and 6.				
	Body weight.	Weight of food.		Average daily ratio of food weight to body weight.		Body weight.	Weight of food.		Average daily ratio of food weight to body weight.	
		Moist.	Dry.	Moist.	Dry.		Moist.	Dry.	Moist.	Dry.
<i>Fore period.</i>										
First subperiod:	<i>Kilos.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Kilos.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>
Total.....	649.57	22,966	5,634	3.54	0.87	1,558.23	62,264	14,132	4.00	0.91
Average.....	64.96	2,297	563			62.33	2,491	565		
Second subperiod:										
Total.....	642.17	23,077	5,654	3.59	.88	1,546.90	64,033	14,363	4.14	.93
Average.....	64.22	2,308	565			61.88	2,561	574		
Entire fore period:										
Total.....	1,291.74	46,043	11,288	3.56	.87	3,105.13	126,297	28,495	4.07	.92
Average.....	64.59	2,302	565			62.10	2,546	570		
<i>Preservative period.</i>										
First subperiod:										
Total.....	641.15	24,446	5,567	3.81	.87	1,544.53	64,217	14,250	4.16	.92
Average.....	64.12	2,445	557			61.78	2,569	570		
Second subperiod:										
Total.....	642.81	22,461	5,522	3.49	.86	1,544.26	64,355	14,044	4.17	.91
Average.....	64.28	2,246	552			61.77	2,574	562		
Third subperiod:										
Total.....	636.75	23,669	5,504	3.72	.86	1,532.88	65,711	13,991	4.29	.91
Average.....	63.68	2,367	550			61.32	2,628	560		
Fourth subperiod:										
Total.....	637.10	23,781	5,491	3.73	.86					
Average.....	63.71	2,378	549							
First, second, and third subperiods:										
Total.....						4,621.67	194,283	42,285	4.20	.91
Average.....						61.62	2,590	565		
Entire preservative period:										
Total.....	2,557.81	94,357	22,084	3.69	.86					
Average.....	63.95	2,359	552							
<i>After period.</i>										
First subperiod:										
Total.....	637.75	22,158	5,420	3.47	.85	1,529.08	63,668	13,818	4.16	.90
Average.....	63.78	2,216	542			61.16	2,547	553		
Second subperiod:										
Total.....	637.62	21,647	5,428	3.39	.85	1,529.05	61,271	13,905	4.01	.91
Average.....	63.76	2,165	542			61.16	2,451	556		
Entire after period:										
Total.....	1,275.37	43,805	10,848	3.43	.85	3,058.13	124,939	27,723	4.09	.91
Average.....	63.77	2,190	542			61.16	2,499	554		



TABLE V.—Amount of moist and dry food consumed, expressed as percentage of body weight, Series VIII—Continued.

SUMMARIES—Continued.

[Averages are per man per day.]

Period.	Nos. 7 to 12.						Nos. 1 to 12 (omitting No. 3).					
	Body weight.	Weight of food.		Average daily ratio of food weight to body weight.		Body weight.	Weight of food.	Weight of food.	Average daily ratio of food weight to body weight.			
		Moist.	Dry.	Moist.	Dry.				Moist.	Dry.		
<i>Fore period.</i>												
First subperiod:												
Total.....	<i>Kilos.</i> 1,929.21	<i>Grams.</i> 78,847	17,270	<i>Per ct.</i> 4.09	0.90	3,487.44	141.111	31,402	4.05	0.90		
Average.....	64.31	2,628	576	.....	.....	63.41	2,596	571	.....	.....		
Second subperiod:												
Total.....	1,925.41	83,002	18,019	4.31	.94	3,472.31	147,035	32,382	4.23	.93		
Average.....	64.18	2,767	601	.....	.....	63.13	2,673	589	.....	.....		
Entire fore period:												
Total.....	3,854.62	161,849	35,289	4.20	.92	6,959.75	288,146	63,784	4.14	.92		
Average.....	64.24	2,697	588	.....	.....	63.27	2,620	580	.....	.....		
<i>Preservative period.</i>												
First subperiod:												
Total.....	1,922.04	79,589	17,570	4.14	.91	3,466.57	143,806	31,820	4.15	.92		
Average.....	64.07	2,653	586	.....	.....	63.03	2,615	579	.....	.....		
Second subperiod:												
Total.....	1,923.25	81,857	17,424	4.26	.91	3,467.51	146,212	31,468	4.22	.91		
Average.....	64.11	2,729	581	.....	.....	63.05	2,658	572	.....	.....		
Third subperiod:												
Total.....	1,916.94	81,323	17,200	4.24	.90	3,449.82	147,034	31,191	4.26	.90		
Average.....	63.90	2,711	573	.....	.....	62.72	2,673	567	.....	.....		
First, second, and third subperiods:												
Total.....	5,762.23	242,769	52,194	4.21	.91	10,383.90	437,052	94,479	4.21	.91		
Average.....	64.02	2,697	580	.....	.....	62.93	2,649	573	.....	.....		
<i>After period.</i>												
First subperiod:												
Total.....	1,910.68	79,114	17,266	4.14	.90	3,439.76	142,782	31,084	4.15	.90		
Average.....	63.69	2,637	576	.....	.....	62.54	2,596	565	.....	.....		
Second subperiod:												
Total.....	1,908.80	76,681	16,522	4.02	.87	3,437.85	137,952	30,427	4.01	.88		
Average.....	63.63	2,556	551	.....	.....	62.51	2,508	553	.....	.....		
Entire after period:												
Total.....	3,819.48	155,795	33,788	4.08	.88	6,877.61	280,734	61,511	4.08	.89		
Average.....	63.66	2,397	563	.....	.....	62.52	2,552	559	.....	.....		

**WEIGHT AND WATER CONTENT OF THE FECES.****INDIVIDUAL DATA.**

In Table VI are given the individual data and summaries of the weight of the moist feces, their water content, and the dry weight thereof. In the case of No. 1 the relative weights of the moist and dry feces and the percentage of water are practically the same for the fore and preservative periods. During the after period the percentage of water and the weight of the feces are considerably increased. The dry feces also are greater in weight than in the other two periods.

No. 2 excretes more than double the weight of feces indicated in the case of No. 1. The water content is diminished during the preservative period, but the total weight of feces is very much increased. There is again an increase in the amount of water in the after period, but a decrease in the weight of the dry and moist feces excreted.

In the case of No. 3 there is a diminution in the water content of the feces during the preservative period, but an increase in the total moist and dry weight of the feces excreted. There is a great diminution, however, in both these weights and also in the percentage of moisture during the after period.

In the case of No. 4 the amount of water in the feces is diminished in the preservative period and the total weight of dry feces is also slightly diminished. The weight of moist and dry feces remains the same in the after period as in the preservative period.

In the case of No. 5 there is a decided increase in the weight of moist and dry feces in the preservative period, but the water content remains practically the same. There is little change in the composition of the feces in the after period as compared with the preservative period.

No. 6 excretes by far the largest quantity of feces of any member of the table, and the water content is also the highest. There is a diminution both in the amount of moist feces and dry feces in the preservative period, though there is a slight increase in the moisture. There is a still further diminution in the quantity of wet and dry feces in the after period, and the amount of moisture therein also decreases.

In the case of No. 7 there is a diminution both in the weight of moist and dry feces and in the percentage of water in the moist feces during the preservative period. There is a great increase in the weight of moist and dry feces in the after period, though the amount of water present is slightly less than in the preservative period.

In the case of No. 8 there is a marked increase in the weight of the moist and dry feces in the preservative period, and the percentage of water is also greater. This increase is continued in a marked degree in the after period.

The data for No. 9 show a decided diminution in the weight of the moist and dry feces excreted. The percentage of water in the feces is also slightly less than in the fore period. In the after period there is a very large increase in the quantity of feces excreted, though the percentage of water therein is not sensibly changed.

In the case of No. 10 there is a marked increase in the weight of the moist feces and the percentage of water therein, and a slight increase in the dry feces during the preservative period. There is a notable increase both in the weight of moist feces and dry feces in the after period, but the percentage of water is less than in the preservative period.

In the case of No. 11 there is a marked increase in the moist and dry feces in the preservative period and a slight decrease in the percentage of water. The data for the after period are almost the same as those for the preservative period.

In the case of No. 12 there is a decrease in moist and dry feces in the preservative period, the water content remaining almost the same as in the fore period. In the after period there is a marked increase in the moist feces without a corresponding increase in the dry feces, due to an increase in the percentage of water.

#### SUMMARIES.

The summary for Nos. 1 and 4 is the only one which is complete for the whole period of observation, inasmuch as they are the only members of the class for whom unbroken data were obtained. The summary shows that in the preservative period there is a slight decrease in the weight of the moist feces excreted, accompanied by a decrease in the percentage of water therein and a very slight decrease in the weight of dry feces excreted. During the after period there is an increase in the weight of moist feces, which is greater than in the fore period. There is an increase in the percentage of moisture as compared with the preservative period, and the weight of dry feces excreted is the same as in the fore period.

The summary for Nos. 1, 2, 4, 5, and 6, who received benzoic acid, is made for the entire series, excluding the fourth preservative sub-period on account of variations in administration of the preservative. A slight increase in the weight of the moist feces is shown in the preservative period, a slight decrease in the percentage of moisture therein, and a slight increase in the weight of the dry feces. In the after period there is a marked loss in the weight of the moist feces and a continued diminution of the percentage of moisture, while the weight of the dry feces is slightly decreased, returning to the figure of the fore period.

The summary for Nos. 7 to 12, inclusive (who received sodium benzoate), covers the entire series, with the exception of the fourth preserv-



ative subperiod, and shows a slight increase in the weight of the moist feces and the percentage of water therein, while the amount of dry feces excreted is the same as in the fore period. In the after period there is a marked increase in the weight of the moist feces with practically no change in the water content as compared with the preservative period, and a correspondingly marked increase in the weight of dry feces excreted.

The summary for Nos. 1 to 12, inclusive, omitting No. 3, also covers the entire observation with the exception of the fourth preservative subperiod. It shows that in the preservative period there is a slight increase in the quantity of moist and dry feces, as well as in the moisture content. In the after period there is again a slight increase in the weight of the moist feces and a slight decrease in the percentage of moisture as compared with the preservative period, while the weight of dry feces excreted is the same as in the preservative period.

The data do not show any notable effect upon the composition of the feces which can be attributed to the preservative administered, but the following points may be noted: There is evidently no pronounced tendency to produce any diarrheal condition, though the quantities of moist and dry feces do not vary in any uniform way in the preservative period as compared with the fore and after periods.

The summary for Nos. 1 to 12 is the most complete expression of the mass action of the preservative, and shows little change in the excretion of the feces, either as respects the weight of the moist and dry feces or the water content. It is fair to conclude, therefore, from a study of these data that the preservative has not produced any effect of a systematic character in these particulars. Attention should be called, however, to the fact that the summary for those receiving benzoic acid (Nos. 1 to 6) and that for those receiving sodium benzoate (Nos. 7 to 12), while agreeing in that they show a slight increase in moist feces excreted and practically no change in the amount of dry feces in the preservative period, show in the first case a continued decrease in moisture throughout and in the other a continued increase. In the after period also opposite tendencies are shown, the weights increasing for Nos. 7 to 12 and decreasing for Nos. 1 to 6. It seems probable, therefore, that the form in which the preservative is administered should be considered in interpreting these results.

TABLE VI.—*Weight and water content of feces, by periods, Series VIII.*

[Averages are per day.]

Period.	No. 1.			No. 2.			No. 3.		
	Feces, moist.	Water con- tent.	Feces, dry.	Feces, moist.	Water con- tent.	Feces, dry.	Feces, moist.	Water con- tent.	Feces, dry.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Grams.</i>
Total.....	134	68.60	42	389	73.34	104	321	71.56	91
Average.....	27		8	78		21	64		18
Second subperiod:									
Total.....	218	70.56	64	480	73.83	126	316	70.54	93
Average.....	44		13	96		25	63		19
Entire fore period:									
Total.....	352	69.89	106	869	73.53	230	637	71.11	184
Average.....	35		11	87		23	64		18
<i>Preservative period.</i>									
First subperiod:									
Total.....	202	69.62	61	482	71.51	137	355	68.37	112
Average.....	40		12	96		27	71		22
Second subperiod:									
Total.....	119	64.74	42	509	71.82	143	430	70.40	127
Average.....	24		8	102		29	86		25
Third subperiod:									
Total.....	237	72.20	66	503	70.22	150	154	66.28	52
Average.....	47		13	101		30	31		10
Fourth subperiod:									
Total.....	136	70.43	40	437	68.92	136	422	70.60	124
Average.....	27		8	87		27	84		25
Entire preservative period:									
Total.....	694	69.88	209	1,931	70.69	566	1,361	69.51	415
Average.....	35		10	97		28	68		21
<i>After period.</i>									
First subperiod:									
Total.....	222	71.12	64	491	72.10	137	210	64.20	75
Average.....	44		13	98		27	42		15
Second subperiod:									
Total.....	231	73.28	62	409	70.42	121	214	65.94	73
Average.....	46		12	82		24	43		15
Entire after period:									
Total.....	453	72.19	126	900	71.33	258	424	65.09	148
Average.....	45		13	90		26	42		15

TABLE VI.—*Weight and water content of feces, by periods, Series VIII—Continued.*

[Averages are per day.]

Period.	No. 4.			No. 5.			No. 6.		
	Feces, moist.	Water con- tent.	Feces, dry.	Feces, moist.	Water con- tent.	Feces, dry.	Feces, moist.	Water con- tent.	Feces, dry.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Grams.</i>
Total.....	323	74.32	83	187	75.34	46	736	77.96	162
Average.....	65		17	37		9	147		32
Second subperiod:									
Total.....	246	72.63	67	308	74.58	78	661	79.60	135
Average.....	49		13	62		16	132		27
Entire fore period:									
Total.....	569	73.64	150	495	74.95	124	1,397	78.74	297
Average.....	57		15	50		12	140		30
<i>Preservative period.</i>									
First subperiod:									
Total.....	274	72.30	76	369	76.48	87	752	80.46	147
Average.....	55		15	74		17	150		29
Second subperiod:									
Total.....	236	71.29	68	251	71.41	72	578	80.98	110
Average.....	47		14	50		14	116		22
Third subperiod:									
Total.....	227	70.23	68	316	76.34	75	639	79.08	134
Average.....	45		14	63		15	128		27
Fourth subperiod:									
Total.....	241	69.36	74	344	72.62	94	585	80.52	114
Average.....	48		15	69		19	117		23
Entire preservative period:									
Total.....	978	70.76	286	1,280	74.38	328	2,554	80.23	505
Average.....	49		14	64		16	128		25
<i>After period.</i>									
First subperiod:									
Total.....	276	71.39	79	382	74.74	96	582	76.58	136
Average.....	55		16	76		19	116		27
Second subperiod:									
Total.....	210	70.60	62	244	74.93	61	332	79.98	66
Average.....	42		12	49		12	66		13
Entire after period:									
Total.....	486	70.99	141	626	74.92	157	914	77.90	202
Average.....	49		14	63		16	91		20



TABLE VI.—Weight and water content of feces, by periods, Series VIII—Continued.

[Averages are per day.]

Period.	No. 7.			No. 8.			No. 9.		
	Feces, moist.	Water con- tent.	Feces, dry.	Feces, moist.	Water con- tent.	Feces, dry.	Feces, moist.	Water con- tent.	Feces, dry.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Grams.</i>
Total.....	464	80.07	92	564	77.72	126	297	69.10	92
Average.....	93		18	113		25	59		18
Second subperiod:									
Total.....	381	76.99	88	182	72.86	49	264	69.38	81
Average.....	76		18	36		10	53		16
Entire fore period:									
Total.....	845	78.70	180	746	76.54	175	561	69.16	173
Average.....	84		18	75		18	56		17
<i>Preservative period.</i>									
First subperiod:									
Total.....	344	77.35	78	559	80.02	112	140	66.56	47
Average.....	69		16	112		22	28		9
Second subperiod:									
Total.....	377	72.08	105	500	79.90	101	264	65.66	91
Average.....	75		21	100		20	53		18
Third subperiod:									
Total.....	337	78.62	72	497	80.10	99	103	61.70	39
Average.....	67		14	99		20	21		8
Fourth subperiod:									
Total.....	296	75.26	73	471	77.64	105	357	73.80	94
Average.....	59		15	94		21	71		19
Entire preservative period:									
Total.....	1,354	75.78	328	2,027	79.43	417	864	68.63	271
Average.....	68		16	101		21	43		14
<i>After period.</i>									
First subperiod:									
Total.....	434	78.22	95	504	78.46	109	260	67.68	84
Average.....	87		19	101		22	52		17
Second subperiod:									
Total.....	402	70.90	117	668	82.49	117	400	69.40	122
Average.....	80		23	134		23	80		24
Entire after period:									
Total.....	836	74.64	212	1,172	80.72	226	660	68.79	206
Average.....	84		21	117		23	66		21

TABLE VI.—*Weight and water content of feces, by periods, Series VIII—Continued.*

[Averages are per day.]

Period.	No. 10.			No. 11.			No. 12.		
	Feces, moist.	Water content.	Feces, dry.	Feces, moist.	Water content.	Feces, dry.	Feces, moist.	Water content.	Feces, dry.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Grams.</i>
Total.....	353	72.84	96	320	76.70	75	520	74.92	130
Average.....	71		19	64		15	104		26
Second subperiod:									
Total.....	198	74.32	51	396	78.75	84	496	77.28	113
Average.....	40		10	79		17	99		23
Entire fore period:									
Total.....	551	73.32	147	716	77.79	159	1,016	76.08	243
Average.....	55		15	72		16	102		24
<i>Preservative period.</i>									
First subperiod:									
Total.....	231	79.32	48	487	74.45	124	648	82.26	115
Average.....	46		10	97		25	130		23
Second subperiod:									
Total.....	551	74.32	141	466	76.02	112	383	74.46	98
Average.....	110		28	93		22	77		20
Third subperiod:									
Total.....	362	80.92	72	296	75.68	72	370	74.44	95
Average.....	72		14	59		14	74		19
Fourth subperiod:									
Total.....	227	71.80	64	408	75.46	100	478	70.84	139
Average.....	45		13	82		20	96		28
Entire preservative period:									
Total.....	1,371	76.29	325	1,657	75.38	408	1,879	76.21	447
Average.....	69		16	83		20	94		22
<i>After period.</i>									
First subperiod:									
Total.....	394	76.16	94	456	76.70	106	540	80.86	103
Average.....	79		19	91		21	108		21
Second subperiod:									
Total.....	379	75.16	94	380	74.56	97	535	79.86	108
Average.....	76		19	76		19	107		22
Entire after period:									
Total.....	773	75.68	188	836	75.72	203	1,075	80.37	211
Average.....	77		19	84		20	108		21

TABLE VI.—*Weight and water content of feces, by periods, Series VIII—Continued.*

## SUMMARY FOR NOS. 1 AND 4 THROUGHOUT SERIES.

[Averages are per man per day.]

Period.	Feces, moist.	Water content.	Feces, dry.	Period.	Feces, moist.	Water content.	Feces, dry.
<i>Fore period.</i>				<i>Preservative period— Continued.</i>			
First subperiod:	<i>Grams.</i>	<i>Per cent.</i>	<i>Grams.</i>	Fourth subperiod:	<i>Grams.</i>	<i>Per cent.</i>	<i>Grams.</i>
Total.....	457	.....	125	Total.....	377	.....	114
Average.....	46	72.65	12	Average.....	38	69.76	11
Second subperiod:				Entire preservative period:			
Total.....	464	.....	131	Total.....	1,672	.....	495
Average.....	46	71.77	13	Average.....	42	70.39	12
Entire fore period:				<i>After period</i>			
Total.....	921	.....	256	First subperiod:			
Average.....	46	72.20	13	Total.....	498	.....	143
<i>Preservative period.</i>				Average.....	50	71.29	14
First subperiod:				Second subperiod:			
Total.....	476	.....	137	Total.....	441	.....	124
Average.....	48	71.22	14	Average.....	44	71.88	12
Second subperiod:				Entire after period:			
Total.....	355	.....	110	Total.....	939	.....	267
Average.....	36	69.02	11	Average.....	47	71.57	13
Third subperiod:							
Total.....	464	.....	134				
Average.....	46	71.12	13				

## SUMMARY FOR NOS. 1, 2, 4, 5, AND 6, OMITTING FOURTH PRESERVATIVE SUBPERIOD.

[Averages are per man per day.]

Period.	Feces, moist.	Water content.	Feces, dry.	Period.	Feces, moist.	Water content.	Feces, dry.
<i>Fore period.</i>				<i>Preservative period— Continued.</i>			
First subperiod:	<i>Grams.</i>	<i>Per cent.</i>	<i>Grams.</i>	Entire preservative period:	<i>Grams.</i>	<i>Per cent.</i>	<i>Grams.</i>
Total.....	1,769	.....	437	Total.....	5,694	.....	1,436
Average.....	71	75.30	17	Average.....	76	74.78	19
Second subperiod:				<i>After period.</i>			
Total.....	1,913	.....	470	First subperiod:			
Average.....	77	75.43	19	Total.....	1,953	.....	512
Entire fore period:				Average.....	78	73.78	20
Total.....	3,682	.....	907	Second subperiod:			
Average.....	74	75.37	18	Total.....	1,426	.....	372
<i>Preservative period.</i>				Average.....	57	73.91	15
First subperiod:				Entire after period:			
Total.....	2,079	.....	508	Total.....	3,379	.....	884
Average.....	83	75.57	20	Average.....	68	73.84	18
Second subperiod:							
Total.....	1,693	.....	435				
Average.....	68	74.31	18				
Third subperiod:							
Total.....	1,922	.....	493				
Average.....	77	74.35	20				



TABLE VI.—*Weight and water content of feces, by periods, Series VIII—Continued.*

SUMMARY FOR NOS. 7 TO 12, OMITTING FOURTH PRESERVATIVE SUBPERIOD.

[Averages are per man per day.]

Period.	Feces, moist.	Water content.	Feces, dry.	Period.	Feces, moist.	Water content.	Feces, dry.
<i>Fore period.</i>				<i>Preservative period— Continued.</i>			
First subperiod:	<i>Grams.</i>	<i>Per cent.</i>	<i>Grams.</i>	Entire preservative			
Total.....	2,518		611	period:			
Average.....	84	75.73	20	Total.....	<i>Grams.</i>	<i>Per cent.</i>	<i>Grams.</i>
Second subperiod:				Average.....	6,915		1,621
Total.....	1,917		466		77	76.56	18
Average.....	64	75.09	16	<i>After period.</i>			
Entire fore period:				First subperiod:			
Total.....	4,435		1,077	Total.....	2,588		591
Average.....	74	75.72	18	Average.....	86	77.16	20
<i>Preservative period.</i>				Second subperiod:			
First subperiod:				Total.....	2,764		655
Total.....	2,409		524	Average.....	92	76.30	22
Average.....	80	78.25	17	Entire after period:			
Second subperiod:				Total.....	5,352		1,246
Total.....	2,541		648	Average.....	89	76.72	21
Average.....	85	74.50	22				
Third subperiod:							
Total.....	1,965		449				
Average.....	66	77.15	15				

SUMMARY FOR NOS. 1 TO 12, OMITTING NO. 3 AND THE FOURTH PRESERVATIVE SUBPERIOD.

[Averages are per man per day.]

Period.	Feces, moist.	Water content.	Feces, dry.	Period.	Feces, moist.	Water content.	Feces, dry.
<i>Fore period:</i>				<i>Preservative period— Continued.</i>			
First subperiod:	<i>Grams.</i>	<i>Per cent.</i>	<i>Grams.</i>	Entire preservative			
Total.....	4,287		1,048	period:			
Average.....	78	75.55	19	Total.....	<i>Grams.</i>	<i>Per cent.</i>	<i>Grams.</i>
Second subperiod:				Average.....	12,609		3,057
Total.....	3,830		936		76	75.76	19
Average.....	70	75.56	17	<i>After period.</i>			
Entire fore period:				First subperiod:			
Total.....	8,117		1,984	Total.....	4,541		1,103
Average.....	74	75.56	18	Average.....	83	75.71	20
<i>Preservative period.</i>				Second subperiod:			
First subperiod:				Total.....	4,190		1,027
Total.....	4,488		1,032	Average.....	76	75.49	19
Average.....	82	77.01	19	Entire after period:			
Second subperiod:				Total.....	8,731		2,130
Total.....	4,234		1,083	Average.....	79	75.60	19
Average.....	77	74.42	20				
Third subperiod:							
Total.....	3,887		942				
Average.....	71	75.77	17				

**THE URINE.****VOLUME, SPECIFIC GRAVITY, AND TOTAL SOLIDS.****INDIVIDUAL DATA.**

In Table VII are found the data relating to the volume of the urine excreted, its specific gravity, and the total solids therein. In the case of No. 1 the volume of the urine is less in the preservative period than in the fore period, and it is still less in the after period than in the preservative period. The total solids excreted are slightly greater in the preservative period and less in the after period than in the fore period. In the case of No. 2 there is a notable increase in the volume of the urine during the preservative period. This increase is partly lost in the after period, but the volume of the urine is still greater than in the fore period. The quantity of total solids excreted is larger in the preservative period than in either of the other periods. In the case of No. 3 there is a diminution in the volume of the urine in the preservative period, but a larger quantity is excreted in the after period than in the fore period. There is little change in the amount of total solids excreted in the three periods, though the quantity is slightly less in both the preservative and after periods than in the fore period.

In the case of No. 4 there is a marked diminution in the volume of the urine in the preservative period which continues, though to a less extent, in the after period. The diminution in the quantity of total solids is not so great as that in the volume, inasmuch as the specific gravity is higher in the preservative period and in the after period than in the fore period. In the case of No. 5 there is also a diminution in the volume of the urine in the preservative period, and the quantity remains almost the same in the after period as in the preservative period. The specific gravity, however, is high and the amount of total solids excreted in the preservative and after periods is greater than in the fore period.

No. 6 also shows a diminution in the volume of urine in the preservative period and a continued decrease in the after period. The total solids excreted in the preservative period are the same as in the fore period, while in the after period there is a loss in the quantity of total solids excreted. In the case of No. 7 there is again a diminution in the volume of the urine in the preservative period and this loss is still more marked in the after period. The total solids excreted are slightly diminished in the preservative period and notably diminished in the after period. In the case of No. 8 the normal volume of urine excreted is very large, but there is a considerable diminution in volume in the preservative period which is partially restored in the after period. Although the volume of the urine varies considerably,

the total solids excreted remain almost the same throughout the three periods. In the case of No. 9 there is an increase in the volume of the urine excreted with practically no diminution in specific gravity, and therefore a considerable increase in total solids. During the after period there is a further increase in the volume of the urine with but little change in the specific gravity and a marked increase in the total solids. In the case of No. 10 there is a notable diminution in the volume of the urine in the preservative period and a notable increase in the after period over the fore period. The total solids excreted are somewhat less in the preservative period than in the fore period, while in the after period they are greater than in the fore period. The case of No. 11 shows a marked diminution in the volume of the urine, but with such an increase in specific gravity that the total solids excreted are greater than in the fore period. The diminution in volume continues during the after period. There is a marked increase in the total solids excreted in the case of No. 11 in the preservative period, although the volume decreases. The amount of total solids in the after period is almost the same as in the fore period. No. 12 shows an increase in the volume of the urine in the preservative period, a slight increase in its specific gravity, and a marked increase in the amount of total solids excreted. In the after period there is again noticed an increase in the volume of the urine, but a diminution of the specific gravity and total solids below the figures for the fore period.

#### SUMMARIES.

The summary for Nos. 1 and 4, which extends over the whole series of observations, shows a notable decrease in the volume of the urine in the preservative period and this decrease is continued in the after period. The decrease in volume is attended with a slight increase of specific gravity and a very small decrease in the total solids in the preservative and after periods. The summaries for Nos. 1, 2, 4, 5, and 6, and Nos. 7 to 12, inclusive, offer a comparison of data for those who received benzoic acid with those who received sodium benzoate. In the former summary it is noticed that the volume of urine is not greatly changed in the preservative period but it is notably less in the after period, the figures being 997, 992, and 922 cc, respectively. The specific gravity is slightly greater in the preservative and after periods than in the fore period, the figures being 1.0230, 1.0246, and 1.0246, respectively. The total solids are increased in the preservative period and somewhat smaller in the after period than in the fore period, the numbers being 55.5, 57.8, and 54.2 grams daily for the three periods, respectively.

In the case of Nos. 7 to 12 there is also a slight loss of volume in the preservative period, and this volume remains practically



unchanged in the after period. The specific gravity is slightly higher in the preservative period than in either the fore or after periods. The total solids are 57.6 grams in the fore period, rise to 60.9 in the preservative period, and fall again to 58.1 in the after period. These data indicate but little change in the volume of the urine, especially as to any effect of the preservative, inasmuch as the weather was growing warmer during the progress of the experiment, and this slight decrease in volume may be accounted for partly by the rise in temperature. There is, however, a tendency shown to increase the amount of total solids excreted under the influence of the preservative. The two points, therefore, brought out by this study are that neither the benzoic acid nor the benzoate of soda has any diuretic effect, but that they do have a tendency to increase slightly the total solids excreted in the urine, and this general effect is further confirmed by the summary for Nos. 1 to 12.

TABLE VII.—Urine determinations—Volume, specific gravity, and total solids, Series VIII.

[Averages are per day.]

Period.	No. 1.			No. 2.			No. 3.		
	Vol- ume.	Specif- ic grav- ity at 25°-25° C.	Total solids (factor 0.245).	Vol- ume.	Specif- ic grav- ity at 25°-25° C.	Total solids (factor 0.245).	Vol- ume.	Specif- ic grav- ity at 25°-25° C.	Total solids (factor 0.245.)
<i>Fore period.</i>									
First subperiod:	<i>cc.</i>		<i>Grams.</i>	<i>cc.</i>		<i>Grams.</i>	<i>cc.</i>		<i>Grams.</i>
Total.....	4,100	1.0297	298.3	6,740	1.0198	326.9	5,880	1.0200	288.1
Average.....	820		59.7	1,348		65.4	1,176		57.6
Second subperiod:									
Total.....	5,435	1.0234	311.6	7,355	1.0208	374.8	6,270	1.0199	305.7
Average.....	1,087		62.3	1,471		75.0	1,254		61.1
Entire fore period:									
Total.....	9,535	1.0266	609.9	14,095	1.0203	701.7	12,150	1.0200	593.8
Average.....	954		61.0	1,410		70.2	1,215		59.4
<i>Preservative period.</i>									
First subperiod:									
Total.....	4,450	1.0280	305.3	7,100	1.0212	368.8	4,670	1.0265	303.2
Average.....	890		61.1	1,420		73.8	934		60.6
Second subperiod:									
Total.....	4,440	1.0284	308.9	8,725	1.0180	384.8	8,450	1.0167	345.7
Average.....	888		61.8	1,745		77.0	1,690		69.1
Third subperiod:									
Total.....	3,990	1.0309	302.1	7,930	1.0197	382.3	5,090	1.0207	298.1
Average.....	798		60.4	1,584		76.5	1,018		54.6
Fourth subperiod:									
Total.....	4,190	1.0306	311.1	6,950	1.0209	355.9	4,265	1.0267	278.9
Average.....	838		62.8	1,390		71.2	853		55.8
Entire preservative period:									
Total.....	17,070	1.0295	1,230.4	30,695	1.0200	1,491.8	22,475	1.0227	1,189.9
Average.....	854		61.5	1,535		74.6	1,124		59.2
<i>After period.</i>									
First subperiod:									
Total.....	4,040	1.0292	289.0	7,040	1.0207	357.0	5,670	1.0220	305.6
Average.....	808		57.8	1,408		71.4	1,134		61.1
Second subperiod:									
Total.....	4,020	1.0274	269.9	7,355	1.0195	351.4	6,830	1.0166	277.8
Average.....	804		54.0	1,471		70.3	1,366		56.6
Entire after period:									
Total.....	8,060	1.0283	558.9	14,395	1.0201	708.4	12,500	1.0193	583.4
Average.....	806		55.9	1,440		70.8	1,250		58.3

TABLE VII.—*Urine determinations—Volume, specific gravity, and total solids, Series VIII—Continued.*

[Averages are per day.]

Period.	No. 4.			No. 5.			No. 6.		
	Vol- ume.	Specif- ic grav- ity at 25°/25° C.	Total solids (factor 0.245).	Vol- ume.	Specif- ic grav- ity at 25°/25° C.	Total solids (factor 0.245).	Vol- ume.	Specif- ic grav- ity at 25°/25° C.	Total solids (factor 0.245).
<i>Fore period.</i>									
First subperiod:	cc.		Grams.	cc.		Grams.	cc.		Grams.
Total.....	4,640	1.0230	261.5	3,885	1.0177	168.5	4,310	1.0274	289.3
Average.....	928		52.3	777		33.7	862		57.9
Second subperiod:									
Total.....	4,885	1.0224	268.1	4,260	1.0196	204.6	4,240	1.0263	273.2
Average.....	977		53.6	852		40.9	848		54.6
Entire fore period:									
Total.....	9,525	1.0227	529.6	8,145	1.0187	373.1	8,550	1.0268	562.5
Average.....	953		53.0	815		37.3	855		56.3
<i>Preservative period.</i>									
First subperiod:									
Total.....	4,645	1.0224	254.9	3,935	1.0228	219.8	4,115	1.0280	282.3
Average.....	929		51.0	787		43.9	823		56.5
Second subperiod:									
Total.....	4,290	1.0248	260.7	3,885	1.0207	197.0	4,300	1.0274	288.7
Average.....	858		52.1	777		39.4	860		57.7
Third subperiod:									
Total.....	4,030	1.0263	259.7	4,200	1.0234	240.8	4,410	1.0261	281.9
Average.....	806		51.9	840		48.2	882		56.4
Fourth subperiod:									
Total.....	3,885	1.0271	257.9	2,570	1.0257	161.8	4,090	1.0272	272.6
Average.....	777		51.6	514		32.4	818		54.5
Entire preservative period:									
Total.....	16,850	1.0252	1,033.2	14,590	1.0232	819.4	16,915	1.0272	1,125.5
Average.....	843		51.7	730		41.0	846		56.3
<i>After period.</i>									
First subperiod:									
Total.....	4,425	1.0266	288.4	3,105	1.0234	178.0	4,215	1.0270	278.8
Average.....	885		57.7	621		35.6	843		55.8
Second subperiod:									
Total.....	3,730	1.0263	240.3	4,160	1.0198	201.8	4,034	1.0258	254.9
Average.....	746		48.1	832		40.4	807		51.0
Entire after period:									
Total.....	8,155	1.0265	528.7	7,265	1.0216	379.8	8,249	1.0264	533.7
Average.....	816		52.9	727		38.0	825		53.4

TABLE VII.—*Urine determinations—Volume, specific gravity, and total solids, Series VIII—Continued.*

[Averages are per day.]

Period.	No. 7.			No. 8.			No. 9.		
	Vol- ume.	Spe- cific gravity at 25°/25° C.	Total solids (factor 0.245).	Vol- ume.	Spe- cific gravity at 25°/25° C.	Total solids (factor 0.245).	Vol- ume.	Spe- cific gravity at 25°/25° C.	Total solids (factor 0.245).
<i>Fore period.</i>									
First subperiod:	cc.		Grams.	cc.		Grams.	cc.		Grams.
Total.....	5,705	1.0194	271.2	8,290	1.0143	290.4	4,475	1.0246	269.7
Average.....	1,141		54.2	1,658		58.1	895		53.9
Second subperiod:									
Total.....	5,820	1.0198	282.3	9,930	1.0115	279.8	5,060	1.0248	307.4
Average.....	1,164		56.5	1,986		56.0	1,012		61.5
Entire fore period:									
Total.....	11,525	1.0196	553.5	18,220	1.0129	570.2	9,535	1.0247	577.1
Average.....	1,153		55.4	1,822		57.0	954		57.7
<i>Preservative period.</i>									
First subperiod:									
Total.....	4,470	1.0247	270.5	8,030	1.0154	302.9	4,280	1.0250	262.2
Average.....	894		54.1	1,606		60.6	856		52.4
Second subperiod:									
Total.....	6,170	1.0182	275.1	7,395	1.0135	244.6	5,260	1.0237	305.4
Average.....	1,234		35.0	1,479		48.9	1,052		61.1
Third subperiod:									
Total.....	5,300	1.0202	262.3	7,820	1.0161	308.5	6,100	1.0237	354.2
Average.....	1,060		52.5	1,564		61.7	1,220		70.8
Fourth subperiod:									
Total.....	4,660	1.0243	277.4	7,160	1.0171	299.9			
Average.....	932		55.5	1,432		60.0			
First, second, and third sub- periods:									
Total.....							15,640	1.0241	921.8
Average.....							1,043		61.5
Entire preservative period:									
Total.....	20,600	1.0219	1,085.3	30,405	1.0155	1,155.9			
Average.....	1,030		54.3	1,520		57.8			
<i>After period.</i>									
First subperiod:									
Total.....	4,125	1.0235	237.5	8,555	1.0145	303.9	5,570	1.0247	337.1
Average.....	825		47.5	1,711		60.8	1,114		67.4
Second subperiod:									
Total.....	4,575	1.0213	238.7	8,775	1.0128	275.2	5,600	1.0245	341.5
Average.....	915		47.7	1,755		55.0	1,138		68.3
Entire after period:									
Total.....	8,700	1.0224	476.2	17,330	1.0137	579.1	11,260	1.0246	678.6
Average.....	870		47.6	1,733		57.9	1,126		67.9



TABLE VII.—*Urine determinations—Volume, specific gravity, and total solids, Series VIII—Continued.*

[Averages are per day.]

Period.	No. 10.			No. 11.			No. 12.		
	Vol- ume.	Spe- cific gravity at 25°/25° C.	Total solids (factor 0.245).	Vol- ume.	Spe- cific gravity at 25°/25° C.	Total solids (factor 0.245).	Vol- ume.	Spe- cific gravity at 25°/25° C.	Total solids (factor 0.245).
<i>Fore period.</i>									
First subperiod:	cc.		Grams.	cc.		Grams.	cc.		Grams.
Total.....	4,980	1.0202	246.5	6,970	1.0195	332.9	6,385	1.0199	311.3
Average.....	996		49.3	1,394		66.6	1,277		62.3
Second subperiod:									
Total.....	5,200	1.0196	249.7	6,060	1.0200	296.9	6,020	1.0214	315.6
Average.....	1,040		49.9	1,212		59.4	1,204		63.1
Entire fore period:									
Total.....	10,180	1.0199	496.2	13,030	1.0198	629.8	12,405	1.0207	626.9
Average.....	1,018		49.6	1,303		63.0	1,241		62.7
<i>Preservative period.</i>									
First subperiod:									
Total.....	5,210	1.0222	283.4	6,080	1.0238	354.5	7,070	1.0210	363.8
Average.....	1,042		56.7	1,216		70.9	1,414		72.8
Second subperiod:									
Total.....	4,490	1.0205	225.5	6,010	1.0225	331.3	6,870	1.0214	360.2
Average.....	898		45.1	1,202		66.3	1,374		72.0
Third subperiod:									
Total.....	5,085	1.0193	240.4	6,355	1.0242	376.8	6,520	1.0223	356.2
Average.....	1,017		48.1	1,271		75.4	1,304		71.2
Fourth subperiod:									
Total.....	3,525	1.0201	173.6	5,330	1.0258	336.9	5,890	1.0211	304.5
Average.....	705		34.7	1,066		67.4	1,178		60.9
Entire preservative period:									
Total.....	18,310	1.0205	922.9	23,775	1.0241	1,399.5	26,350	1.0212	1,384.7
Average.....	916		46.1	1,189		70.0	1,318		69.2
<i>After period.</i>									
First subperiod:									
Total.....	6,370	1.0176	274.7	4,720	1.0275	318.0	6,795	1.0196	326.3
Average.....	1,274		54.9	944		63.6	1,359		65.3
Second subperiod:									
Total.....	5,015	1.0200	245.7	5,030	1.0248	305.6	7,050	1.0162	279.8
Average.....	1,003		49.1	1,006		61.1	1,410		56.0
Entire after period:									
Total.....	11,385	1.0185	520.4	9,750	1.0262	623.6	13,845	1.0179	606.1
Average.....	1,139		52.0	975		62.4	1,385		60.6

TABLE VII.—*Urine determinations—Volume, specific gravity, and total solids, Series VIII—Continued.*

## SUMMARIES.

[Averages are per man per day.]

Period.	Nos. 1 and 4.			Nos. 1, 2, 4, 5, and 6.		
	Volume.	Specific gravity at 25°/25° C.	Total solids (factor 0.245).	Volume.	Specific gravity at 25°/25° C.	Total solids (factor 0.245).
<i>Fore period.</i>						
First subperiod:	cc.		Grams.	cc.		Grams.
Total.....	8,740	1.0264	559.8	23,675	1.0235	1,344.5
Average.....	874		56.0	947		53.8
Second subperiod:						
Total.....	10,320	1.0229	579.7	26,175	1.0225	1,432.3
Average.....	1,032		58.0	1,047		57.3
Entire fore period:						
Total.....	19,060	1.0247	1,139.5	49,850	1.0230	2,776.8
Average.....	953		57.0	997		55.5
<i>Preservative period.</i>						
First subperiod:						
Total.....	9,065	1.0252	560.2	24,245	1.0245	1,431.1
Average.....	910		56.0	970		57.2
Second subperiod:						
Total.....	8,730	1.0206	569.6	25,640	1.0239	1,440.1
Average.....	873		57.0	1,026		57.6
Third subperiod:						
Total.....	8,020	1.0286	561.8	24,550	1.0253	1,466.8
Average.....	802		56.2	982		58.7
First, second, and third subperiods:						
Total.....				74,435	1.0246	4,338.0
Average.....				992		57.8
Fourth subperiod:						
Total.....	8,075	1.0289	572.0			
Average.....	808		57.2			
Entire preservative period:						
Total.....	33,920	1.0274	2,263.6			
Average.....	848		56.6			
<i>After period.</i>						
First subperiod:						
Total.....	8,465	1.0279	577.4	22,825	1.0254	1,391.2
Average.....	847		57.7	913		55.6
Second subperiod:						
Total.....	7,750	1.0269	510.2	23,299	1.0238	1,318.3
Average.....	775		51.0	932		52.7
Entire after period:						
Total.....	16,215	1.0274	1,087.6	46,124	1.0246	2,709.5
Average.....	811		54.4	922		54.2

TABLE VII.—*Urine determinations—Volume, specific gravity, and total solids, Series VIII—Continued.*

## SUMMARIES—Continued.

[Averages are per man per day.]

Period.	Nos. 7 to 12.			Nos. 1 to 12 (omitting No. 3).		
	Volume.	Specific gravity at 25°/25° C.	Total solids (factor 0.245).	Volume.	Specific gravity at 25°/25° C.	Total solids (factor 0.245).
<i>Fore period.</i>						
First subperiod:			<i>Grams.</i>	<i>cc.</i>		<i>Grams.</i>
Total.....	36, 805	1. 0197	1, 722. 0	60, 480	1. 0213	3, 066. 5
Average.....	1, 227		57. 4	1, 100		55. 8
Second subperiod:						
Total.....	38, 090	1. 0195	1, 731. 7	64, 265	1. 0209	3, 164. 0
Average.....	1, 270		57. 7	1, 168		57. 5
Entire fore period:						
Total.....	74, 895	1. 0196	3, 453. 7	124, 745	1. 0211	6, 230. 5
Average.....	1, 248		57. 6	1, 134		56. 6
<i>Preservative period.</i>						
First subperiod:						
Total.....	35, 140	1. 0220	1, 837. 3	59, 385	1. 0231	3, 268. 4
Average.....	1, 171		61. 2	1, 080		59. 4
Second subperiod:						
Total.....	36, 195	1. 0200	1, 742. 1	61, 835	1. 0217	3, 182. 2
Average.....	1, 207		58. 1	1, 124		57. 9
Third subperiod:						
Total.....	37, 180	1. 0210	1, 898. 4	61, 730	1. 0229	3, 365. 2
Average.....	1, 239		63. 3	1, 122		61. 2
First, second, and third subperiods:						
Total.....	108, 515	1. 0210	5, 477. 8	182, 950	1. 0226	9, 815. 8
Average.....	1, 206		60. 9	1, 109		59. 5
<i>After period.</i>						
First subperiod:						
Total.....	36, 135	1. 0212	1, 797. 5	58, 960	1. 0231	3, 188. 7
Average.....	1, 205		59. 9	1, 072		58. 0
Second subperiod:						
Total.....	36, 135	1. 0199	1, 686. 5	59, 434	1. 0216	3, 004. 8
Average.....	1, 205		56. 2	1, 081		54. 6
Entire after period:						
Total.....	72, 270	1. 0206	3, 484. 0	118, 394	1. 0224	6, 193. 5
Average.....	1, 205		58. 1	1, 076		56. 3

## RATIO OF SULPHUR, SULPHATES, AND PHOSPHATES TO NITROGEN EXCRETED IN THE URINE.

## INDIVIDUAL DATA.

In Table VIII are given the data relating to the comparative quantities of sulphur, sulphates, and phosphates excreted in the urine to the nitrogen therein. The object of this study was to determine whether the administration of the preservative in the form either of benzoic acid or sodium benzoate disturbs in any notable degree the proteid metabolism as shown by the relation existing between the sulphur, sulphates, and phosphates excreted in the urine and the nitrogen therein. The data show that the total nitrogen in the urine in the case of No. 1 is almost the same in the fore period and the preservative period but is diminished considerably in the after period. The ratio



of the sulphates as  $\text{SO}_3$  is slightly decreased in the preservative period and is the same in the after period as in the fore period. The ratio of phosphoric acid is increased in the preservative period and slightly increased in the after period.

In the case of No. 2 the quantity of nitrogen excreted in the urine is markedly increased in the preservative period while it is almost the same in the fore and after periods. The ratio of the total sulphur to the nitrogen is slightly increased in the preservative period and again in the after period. The ratio of sulphates as  $\text{SO}_3$  is the same in the fore and preservative periods and is slightly diminished in the after period. The phosphoric acid ratio is slightly increased in the preservative period and remains the same in the after period as in the preservative period.

The quantity of nitrogen excreted in the urine in the case of No. 3 in all the three periods is almost the same, being slightly less in the after period. The total sulphur ratio is the same in the fore and preservative periods and is notably increased in the after period. The ratio of sulphates as  $\text{SO}_3$  to nitrogen is practically the same throughout the observation. The phosphoric acid ratio is slightly less in the preservative period and is practically the same in the after period.

In the case of No. 4 there is slightly less nitrogen in the urine in the preservative period than in either the fore or after periods. The ratio of total sulphur is slightly increased in the preservative and after periods. The sulphate ratio is practically the same throughout the observation. The phosphoric acid ratio is decidedly increased in the preservative period and again increased to even a greater extent in the after period.

The total quantity of nitrogen in the urine in the case of No. 5 is notably larger in the preservative period than in the fore or after period. The ratio of total sulphur is increased in the preservative and after periods. The sulphate ratio is diminished in the preservative period while in the after period it rises almost to the same magnitude as in the fore period. The phosphoric acid ratio is increased in the preservative period and in the after period falls again by about half the quantity of the increase. In the case of No. 6 the quantity of nitrogen is decreased in the preservative period. The ratio of the sulphur is the same in the fore and preservative periods and is decidedly increased in the after period. The ratio of the sulphates as  $\text{SO}_3$  is almost the same in all the periods. The ratio of phosphoric acid is diminished in the preservative and after periods.

In the case of No. 7 the total quantity of nitrogen is less in the preservative period and decidedly less in the after period. The ratio of sulphur remains the same in all the periods. The ratio of sulphates is slightly diminished in the preservative period while there is a very

slight increase in the after period. The ratio of the phosphoric acid is notably increased in both the preservative and after periods.

No. 8 shows a slightly increased excretion of the nitrogen in the preservative and after periods. The ratio of the total sulphur is markedly increased both in the preservative and after periods. The ratio of the sulphates remains nearly constant throughout, while the ratio of phosphoric acid increases both in the preservative and after periods.

No. 9 shows a slight increase in the nitrogen excreted both in the preservative and after periods. The sulphur ratio is increased both in the preservative and after periods, while the sulphate ratio is very slightly increased in the preservative period and falls again in the after period to almost the same magnitude as the fore period. The phosphoric acid ratio is notably increased both in the preservative and after periods.

In the case of No. 10 there is but little change in the amount of nitrogen excreted, though there is a larger quantity in the preservative period and a slightly larger quantity in the after period than in the fore period. The ratio of the total sulphur is notably increased both in the preservative and after periods. The ratio of the sulphates remains almost constant throughout. The ratio of phosphoric acid is notably increased in the preservative period and to a less extent in the after period.

In the case of No. 11 there is a notable increase in the quantity of nitrogen excreted in the preservative period. The ratio of the sulphur is largely increased in the preservative period. The sulphate ratio is almost the same throughout, while the phosphoric acid ratio is notably increased in both the preservative and after periods.

No. 12 shows an increase of the nitrogen excreted in the preservative period. The sulphur ratio is slightly larger in the preservative period, the sulphates ratio remains unchanged throughout, and there is but little change in the phosphoric acid ratio, which is slightly larger in the preservative period.

#### SUMMARIES.

A summary of Nos. 1 and 4 is made for the whole period. This summary shows very little variation in the excretion of nitrogen, an increase in the sulphur ratio both in the preservative and after periods, no change in the sulphate ratio, and a notable increase in the phosphoric-acid ratio in the preservative period and a greater increase in the after period.

The summary for Nos. 1, 2, 4, 5, and 6 shows a slight increase in the quantity of nitrogen excreted in the preservative period and a decrease of slightly greater magnitude in that excreted in the after period. The ratio of the sulphur to the nitrogen is increased in both

the preservative and after periods. The ratio of the sulphates is almost the same in all the periods, while the ratio of phosphoric acid to the nitrogen is increased in both the preservative period and the after period.

The summary for those who received benzoic acid shows a tendency on the part of this preservative to decrease the relative quantities of sulphur and phosphoric acid excreted in the preservative period as compared with the total nitrogen excreted, and there is no change in the relative quantity of sulphates expressed as  $\text{SO}_3$ .

The summary for Nos. 7 to 12, inclusive, shows a slight increase in the quantity of nitrogen excreted in the preservative period. There is also an increase in the ratio of the sulphur both in the preservative and after periods. The ratio of the sulphates remains the same in all the periods, but there is an increase in the ratio of phosphoric acid both in the preservative and in the after period. These data for the subjects using sodium benzoate indicate the same tendency, though less pronounced, as was shown for Nos. 1 to 6 receiving benzoic acid, namely, a relative decrease in the amounts of  $\text{P}_2\text{O}_5$  and sulphur excreted, as compared with the nitrogen.

The final summary includes all the men except No. 3 and all the periods except the fourth preservative period. These data show a slight increase in the quantity of nitrogen in the urine in the preservative period and a decrease of somewhat greater magnitude in the after period. The sulphur ratio is slightly increased in the preservative period and still further increased in the after period. The sulphate ratio remains the same in all the periods. The phosphoric acid ratio is increased in the preservative period and again increased in the after period. This summary of necessity confirms the uniform tendency manifested in the preceding cases to decrease the excretion of sulphur and of phosphoric acid in relation to the quantity of nitrogen excreted, while no effect is produced upon the excretion of the sulphates in the urine in relation to the quantity of nitrogen.



TABLE VIII.—*Urine determinations—Ratio of sulphur, sulphates, and phosphates to nitrogen, Series VIII.*  
[Averages are per day.]

Period.	No. 1.					No. 2.									
	Quantity.			Ratio.		Quantity.			Ratio.						
	Nitrogen.	Sulphur.	SO <sub>3</sub> .	P <sub>2</sub> O <sub>5</sub> .	S : N.	SO <sub>3</sub> :N.	P <sub>2</sub> O <sub>5</sub> :N.	Nitrogen.	Sulphur.	SO <sub>3</sub> .	P <sub>2</sub> O <sub>5</sub> .	S : N.	SO <sub>3</sub> :N.	P <sub>2</sub> O <sub>5</sub> :N.	
<i>Fore period.</i>	Grams.	Grams.	Grams.	Grams.				Grams.	Grams.	Grams.	Grams.				
	58.26	4.431	9.430	10.674	1:13.1	1:6.2	1:5.5	73.13	5.248	11.195	15.664	1:13.9	1:6.5	1:4.7	
	11.65	.886	1.886	2.135				14.62	1.050	2.239	3.133				
	Average.....														
	65.93	4.867	10.317	11.389	1:13.5	1:6.4	1:5.8	90.25	6.086	12.892	17.187	1:14.8	1:7.0	1:5.3	
Entire fore period:	Total.....														
	124.19	9.298	19.747	22.063	1:13.4	1:6.3	1:5.6	163.38	11.334	24.087	32.851	1:14.4	1:6.8	1:5.0	
<i>Preservative period.</i>	Average.....	12.42	.930	1.975				16.34	1.133	2.409	3.285				
	First subperiod:														
	Total.....	66.44	4.730	10.720	10.000	1:14.0	1:6.2	1:6.6	88.32	5.987	12.827	16.621	1:14.8	1:6.9	1:5.3
	Average.....	13.29	.946	2.144	2.000				17.66	1.197	2.565	3.324			
	Second subperiod:														
Total.....	61.18	4.735	10.079	9.728	1:12.9	1:6.1	1:6.3	86.12	5.968	12.721	17.157	1:14.4	1:6.8	1:5.0	
Third subperiod:	Average.....	12.24	.947	2.016	1.946				17.22	1.194	2.544	3.431			
	Total.....	65.87	4.767	10.558	10.309	1:13.8	1:6.2	1:6.4	88.47	5.950	12.905	16.873	1:14.9	1:6.9	1:5.2
Fourth subperiod:	Average.....	13.17	.953	2.112	2.062				17.69	1.190	2.581	3.375			
	Total.....	64.36	4.678	10.291	9.382	1:13.8	1:6.3	1:6.9	83.12	5.737	12.302	15.436	1:14.5	1:6.8	1:5.4
Entire preservative period:	Average.....	12.87	.936	2.058	1.876				16.62	1.147	2.460	3.087			
	Total.....	257.85	18.910	41.648	39.419	1:13.6	1:6.2	1:6.5	346.03	23.642	50.755	66.087	1:14.6	1:6.8	1:5.2
<i>After period.</i>	Average.....	12.89	.946	2.082	1.971				17.30	1.182	2.538	3.304			
	First subperiod:														
	Total.....	58.42	4.311	9.486	7.897	1:13.6	1:6.2	1:7.4	82.23	5.545	12.272	15.361	1:14.8	1:6.7	1:5.4
	Average.....	11.68	.862	1.897	1.579				16.45	1.109	2.454	3.072			
	Second subperiod:														
Total.....	55.64	3.973	8.715	7.882	1:14.0	1:6.4	1:7.1	82.38	5.616	12.283	16.268	1:14.7	1:6.7	1:5.1	
Entire after period:	Average.....	11.13	.795	1.743	1.576				16.48	1.123	2.457	3.254			
	Total.....	114.06	8.284	18.201	15.779	1:13.8	1:6.3	1:7.2	164.61	11.161	24.555	31.629	1:14.7	1:6.7	1:5.2
Average.....	11.41	.828	1.820	1.578				16.46	1.116	2.456	3.163				

Period.	No. 3.						No. 4.					
	Quantity.			Ratio.			Quantity.			Ratio.		
	Nitrogen.	Sulphur.	SO <sub>3</sub> .	P <sub>2</sub> O <sub>5</sub> .	S: N.	SO <sub>3</sub> :N.	Nitrogen.	Sulphur.	SO <sub>3</sub> .	P <sub>2</sub> O <sub>5</sub> .	S: N.	SO <sub>3</sub> :N.
<i>Fore period.</i>												
First subperiod:												
Total.....	Grams. 70.97	Grams. 5.027	Grams. 11.005	Grams. 12.546	1:14.1	1:6.4	Grams. 60.55	Grams. 4.301	Grams. 9.582	Grams. 11.600	1:13.8	1:6.3
Average.....	14.19	1.005	2.201	2.509			12.11	.878	1.916	2.322		
Second subperiod:												
Total.....	72.29	4.986	10.754	12.024	1:14.5	1:6.0	70.49	4.914	10.630	10.485	1:14.3	1:6.6
Average.....	14.46	.997	2.151	2.405			14.10	.983	2.126	2.097		
Entire fore period:												
Total.....	143.26	10.013	21.759	24.570	1:14.3	1:6.6	131.04	9.305	20.212	22.094	1:14.1	1:6.5
Average.....	14.33	1.001	2.176	2.457			13.10	.931	2.021	2.209		
<i>Preservative period.</i>												
First subperiod:												
Total.....	73.51	5.224	11.628	12.901	1:14.1	1:6.3	67.96	4.663	10.470	10.526	1:14.6	1:6.5
Average.....	14.70	1.045	2.326	2.580			13.59	.933	2.094	2.105		
Second subperiod:												
Total.....	74.44	5.124	11.323	18.594	1:14.5	1:6.6	63.11	4.278	9.434	10.203	1:14.8	1:6.7
Average.....	14.89	1.025	2.265	3.719			12.62	.856	1.887	2.041		
Third subperiod:												
Total.....	71.31	4.939	10.811	10.751	1:14.4	1:6.6	61.66	4.204	9.329	9.682	1:14.7	1:6.6
Average.....	14.26	.988	2.162	2.150			12.33	.841	1.866	1.936		
Fourth subperiod:												
Total.....	65.51	4.607	10.236	10.324	1:14.2	1:6.4	61.93	4.335	9.340	9.263	1:14.3	1:6.6
Average.....	13.10	.921	2.047	2.065			12.39	.867	1.868	1.853		
Entire preservative period:												
Total.....	284.77	19.894	43.998	52.570	1:14.3	1:6.5	254.66	17.480	38.573	39.674	1:14.6	1:6.6
Average.....	14.24	.995	2.200	2.629			12.73	.874	1.920	1.984		
<i>After period.</i>												
First subperiod:												
Total.....	70.53	4.692	10.976	11.863	1:15.3	1:6.4	70.45	4.695	10.593	10.131	1:15.0	1:6.7
Average.....	14.11	2.190	2.195	2.373			14.09	.939	2.119	2.026		
Second subperiod:												
Total.....	65.77	4.497	10.032	12.984	1:14.8	1:6.6	59.79	4.180	9.347	8.072	1:14.3	1:6.4
Average.....	13.15	.887	2.006	2.597			11.96	.836	1.869	1.614		
Entire after period:												
Total.....	136.30	9.089	21.008	24.847	1:15.1	1:6.5	139.24	8.875	19.940	18.203	1:14.7	1:6.5
Average.....	13.63	.904	2.101	2.485			13.92	.888	1.994	1.820		

TABLE VIII.—*Urine determinations—Ratio of sulphur, sulphates, and phosphates to nitrogen, Series VIII—Continued.*  
[Averages are per day.]

Period.	No. 5.				No. 6.								
	Quantity.		Ratio.		Quantity.		Ratio.						
	Nitrogen.	Sulphur.	SO <sub>3</sub> .	P <sub>2</sub> O <sub>5</sub> .	S: N.	SO <sub>3</sub> :N.	P <sub>2</sub> O <sub>5</sub> .	S: N.	SO <sub>3</sub> :N.	P <sub>2</sub> O <sub>5</sub> :N.			
<i>Fore period.</i>													
First subperiod:													
Total.....	Grams. 41.85	Grams. 2.915	Grams. 6.204	Grams. 9.251	1:14.4	1:6.7	1:4.5	Grams. 66.55	Grams. 4.670	Grams. 9.952	1:14.3	1:6.7	1:5.8
Average.....	8.37	.583	1.241	1.890				13.31	.934	1.990			
Second subperiod:													
Total.....	42.34	2.820	5.880	7.683	1:15.0	1:7.2	1:5.5	69.15	4.650	9.905	1:14.9	1:7.0	1:6.3
Average.....	8.47	.564	1.178	1.537				13.83	.930	1.981			
Entire fore period:													
Total.....	84.19	5.735	12.093	16.934	1:14.7	1:7.0	1:5.0	135.70	9.320	19.857	1:14.6	1:6.8	1:6.1
Average.....	8.42	.574	1.209	1.693				13.57	.932	1.986			
<i>Preservative period.</i>													
First subperiod:													
Total.....	44.43	3.078	6.646	8.548	1:14.4	1:6.7	1:5.2	64.24	4.374	9.473	1:14.7	1:6.8	1:5.7
Average.....	8.89	.616	1.329	1.710				12.85	.875	1.895			
Second subperiod:													
Total.....	40.63	3.421	7.341	8.776	1:14.5	1:6.8	1:5.7	66.18	4.530	9.795	1:14.6	1:6.8	1:5.8
Average.....	9.93	.684	1.468	1.755				13.24	.906	1.939			
Third subperiod:													
Total.....	53.63	3.431	7.728	8.757	1:15.6	1:6.9	1:6.1	65.09	4.509	9.676	1:14.4	1:6.7	1:6.1
Average.....	10.73	.686	1.546	1.751				13.02	.902	1.935			
Fourth subperiod:													
Total.....	44.11	3.066	6.778	7.718	1:14.4	1:6.5	1:5.7	63.52	4.289	9.350	1:14.8	1:6.8	1:5.7
Average.....	8.82	.613	1.356	1.544				12.70	.858	1.870			
Entire preservative period:													
Total.....	191.80	12.906	28.493	33.799	1:14.8	1:6.7	1:5.7	259.03	17.702	38.294	1:14.6	1:6.8	1:5.8
Average.....	9.59	.650	1.425	1.690				12.95	.885	1.915			
<i>After period.</i>													
First subperiod:													
Total.....	45.53	2.953	6.612	8.469	1:15.4	1:6.9	1:5.4	64.87	4.118	9.366	1:15.8	1:6.9	1:5.7
Average.....	9.11	.591	1.322	1.694				12.97	.824	1.873			
Second subperiod:													
Total.....	41.81	2.892	5.974	7.709	1:14.9	1:7.0	1:5.4	60.46	4.088	9.228	1:14.8	1:6.6	1:5.7
Average.....	8.36	.560	1.195	1.542				12.09	.818	1.846			
Entire after period:													
Total.....	87.34	5.755	12.586	16.178	1:15.2	1:6.9	1:5.4	125.33	8.206	18.594	1:15.3	1:6.7	1:5.7
Average.....	8.73	.576	1.259	1.618				12.53	.821	1.859			

<sup>a</sup> Average added to complete record.



Period.	No. 7.						No. 8.					
	Quantity.			Ratio.			Quantity.			Ratio.		
	Nitrogen.	Sulphur.	SO <sub>3</sub> .	P <sub>2</sub> O <sub>5</sub> .	S : N.	SO <sub>3</sub> : N.	Nitrogen.	Sulphur.	SO <sub>3</sub> .	P <sub>2</sub> O <sub>5</sub> .	S : N.	SO <sub>3</sub> : N.
<i>Fore period.</i>												
First subperiod:												
Total.....	Grams. 62.01	Grams. 4.423	Grams. 9.589	Grams. 1.918	1:14.0	1:6.5	Grams. 55.38	Grams. 4.133	Grams. 8.618	Grams. 1.660	1:13.4	1:6.4
Average.....	12.40	.885	1.918	1.971			11.08	.827	1.832			
Second subperiod:												
Total.....	61.92	4.576	9.519	9.239	1:13.5	1:6.5	56.68	4.132	8.901	9.458	1:14.4	1:6.3
Average.....	12.38	.915	1.904	1.848			11.94	.826	1.780	1.892		
Entire fore period:												
Total.....	123.93	8.999	19.108	19.093	1:13.8	1:6.5	115.06	8.265	17.519	18.618	1:13.9	1:6.2
Average.....	12.39	.900	1.911	1.909			11.51	.827	1.752	1.862		
<i>Preservative period.</i>												
First subperiod:												
Total.....	61.95	4.564	9.897	8.903	1:13.6	1:6.3	62.47	4.373	9.283	10.152	1:14.3	1:6.2
Average.....	12.39	.913	1.979	1.781			12.49	.875	1.857	2.030		
Second subperiod:												
Total.....	55.96	3.987	8.686	8.377	1:14.0	1:6.4	61.29	4.253	9.106	10.481	1:14.4	1:5.8
Average.....	11.19	.797	1.737	1.675			12.26	.851	1.833	2.096		
Third subperiod:												
Total.....	54.17	3.796	8.370	7.685	1:14.3	1:6.5	58.88	4.113	8.865	8.649	1:14.3	1:6.8
Average.....	10.83	.759	1.674	1.537			11.78	.823	1.773	1.730		
Fourth subperiod:												
Total.....	60.72	4.464	9.721	7.939	1:13.6	1:6.2	61.29	4.047	8.947	8.988	1:15.1	1:6.8
Average.....	12.14	.893	1.944	1.588			12.26	.809	1.789	1.798		
Entire preservative period:												
Total.....	232.80	16.811	36.674	32.904	1:13.8	1:6.3	243.93	16.786	36.261	38.270	1:14.5	1:6.4
Average.....	11.64	.841	1.834	1.645			12.20	.839	1.813	1.914		
<i>After period.</i>												
First subperiod:												
Total.....	50.94	3.603	7.943	7.398	1:14.1	1:6.4	62.19	4.074	9.409	8.094	1:15.3	1:6.6
Average.....	10.19	.721	1.589	1.480			12.44	.815	1.894	1.739		
Second subperiod:												
Total.....	53.80	3.496	8.489	7.193	1:13.5	1:6.3	62.39	4.182	9.544	9.560	1:14.9	1:6.5
Average.....	10.76	.766	1.698	1.439			12.48	.836	1.909	1.912		
Entire after period:												
Total.....	104.74	7.569	16.432	14.591	1:13.8	1:6.4	124.58	8.256	19.013	18.254	1:15.1	1:6.8
Average.....	10.47	.760	1.643	1.459			12.46	.826	1.901	1.835		

TABLE VIII.—Urine determinations—Ratio of sulphur, sulphates, and phosphates to nitrogen, Series VIII—Continued.

Period.	No. 9.						No. 10.					
	Quantity.			Ratio.			Quantity.			Ratio.		
	Nitrogen.	Sulphur.	SO <sub>2</sub> .	P <sub>2</sub> O <sub>5</sub> .	S : N.	SO <sub>2</sub> :N.	Nitrogen.	Sulphur.	SO <sub>2</sub> .	P <sub>2</sub> O <sub>5</sub> .	S : N.	SO <sub>2</sub> :N.
<i>Fer period.</i>												
First subperiod:												
Total.....	Grams. a 68.98 13.80	Grams. 4.833 .967	Grams. 10.871 2.174	Grams. 13.154 2.631	1:14.3	1:5.2	Grams. 53.83 10.57	Grams. 3.861 .772	Grams. 8.158 1.632	Grams. 10.562 2.112	1:13.9	1:6.6
Average.....												
Second subperiod:												
Total.....	68.46	4.753	10.667	11.246	1:14.4	1:6.1	57.82	3.842	8.263	9.774	1:15.0	1:7.0
Average.....	13.69	.951	2.133	2.249			11.56	.708	1.633	1.955		1:5.9
Entire fore period:												
Total.....	137.44	9.586	21.538	24.400	1:14.3	1:5.6	111.65	7.703	16.421	20.336	1:14.5	1:6.8
Average.....	13.74	.959	2.154	2.440			11.17	.770	1.642	2.034		1:5.5
<i>Preservative period.</i>												
First subperiod:												
Total.....	a 70.63 14.13	4.861 .972	10.732 2.146	11.772 2.354	1:14.5	1:6.0	67.57 13.51	4.304 .879	9.691 1.938	11.172 2.234	1:15.4	1:7.0
Average.....												
Second subperiod:												
Total.....	64.96 12.99	4.464 .893	9.981 1.996	10.589 2.118	1:14.6	1:6.1	a 62.75 12.55	4.236 .847	9.329 1.866	10.563 2.113	1:14.8	1:6.7
Average.....												
Third subperiod:												
Total.....	75.76 15.14	5.219 1.044	11.450 2.290	11.336 2.267	1:14.5	1:6.7	54.46 10.89	3.555 .711	7.600 1.522	8.298 1.660	1:15.3	1:7.2
Average.....												1:6.6
Fourth subperiod:												
Total.....												
Average.....												
First, second, and third sub- periods:												
Total.....	211.29	14.544	32.163	33.697	1:14.5	1:6.3	a 48.25 9.65	3.244 .649	7.008 1.402	8.429 1.686	1:14.9	1:6.9
Average.....	14.69	.970	2.144	2.246								
Entire preservative period:												
Total.....							233.03	15.429	33.637	38.462	1:15.1	1:6.1
Average.....							11.65	.771	1.682	1.923		1:6.1





TABLE VIII.—*Urine determinations—Ratio of sulphur, sulphates, and phosphates to nitrogen, Series VIII—Continued.*  
 [Averages are per day.]

Period.	No. 11.						No. 12.					
	Quantity.			Ratio.			Quantity.			Ratio.		
	Nitrogen.	Sulphur.	SO <sub>3</sub> .	P <sub>2</sub> O <sub>5</sub> .	SO <sub>3</sub> :N.	P <sub>2</sub> O <sub>5</sub> :N.	Nitrogen.	Sulphur.	SO <sub>3</sub> .	P <sub>2</sub> O <sub>5</sub> .	SO <sub>3</sub> :N.	P <sub>2</sub> O <sub>5</sub> :N.
<i>Forc period.</i>												
First subperiod:												
Total.....	Grams. 71.23	Grams. 5.180	Grams. 11.031	Grams. 13.543	1:13.7	1:5.3	Grams. 62.96	Grams. 4.507	Grams. 9.558	Grams. 11.596	1:14.0	1:5.4
Average.....	14.25	1.038	2.006	2.709			12.59	.901	1.912	2.319		1:6.6
Second subperiod:												
Total.....	69.08	4.569	10.028	10.929	1:15.1	1:6.3	68.27	4.605	9.974	12.080	1:14.8	1:5.7
Average.....	13.82	.914	2.006	2.186			13.65	.921	1.995	2.416		
Entire forc period:												
Total.....	140.31	9.758	21.059	24.472	1:14.4	1:5.7	131.23	9.112	19.532	23.676	1:14.4	1:5.5
Average.....	14.03	.976	2.107	2.447			13.12	.911	1.953	2.368		
<i>Preservative period.</i>												
First subperiod:												
Total.....	81.41	5.357	12.077	13.208	1:15.2	1:6.2	75.79	5.277	11.458	13.306	1:14.4	1:5.7
Average.....	16.28	1.071	2.415	2.642			15.16	1.055	2.292	2.661		
Second subperiod:												
Total.....	67.67	4.655	10.366	11.030	1:14.5	1:6.1	71.38	4.883	10.657	12.737	1:14.6	1:5.6
Average.....	13.53	.931	2.073	2.206			14.28	.977	2.131	2.547		
Third subperiod:												
Total.....	84.01	5.437	12.537	13.250	1:15.5	1:6.3	71.59	4.925	10.459	11.526	1:14.5	1:6.2
Average.....	16.80	1.087	2.507	2.650			14.32	.985	2.092	2.305		
Fourth subperiod:												
Total.....	78.72	5.241	11.843	12.904	1:15.0	1:6.1	61.37	4.146	9.181	11.266	1:14.8	1:5.4
Average.....	15.74	1.048	2.369	2.581			12.27	.829	1.836	2.253		
Entire preservative period:												
Total.....	311.81	20.690	46.823	50.392	1:15.1	1:6.2	280.13	19.231	41.755	48.835	1:14.6	1:5.7
Average.....	15.59	1.035	2.341	2.520			14.01	.902	2.088	2.442		
<i>After period.</i>												
First subperiod:												
Total.....	72.07	5.027	11.064	11.004	1:14.3	1:6.5	62.92	4.195	9.249	10.765	1:15.0	1:5.8
Average.....	14.41	1.005	2.213	2.201			12.58	.839	1.850	2.153		
Second subperiod:												
Total.....	75.40	5.223	11.237	11.366	1:14.4	1:6.6	58.39	4.199	8.804	10.747	1:14.0	1:5.5
Average.....	15.08	1.045	2.247	2.273			11.72	.840	1.761	2.149		
Entire after period:												
Total.....	147.47	10.250	22.301	22.370	1:14.4	1:6.6	121.51	8.394	18.053	21.512	1:14.5	1:5.6
Average.....	14.75	1.025	2.230	2.237			12.15	.839	1.805	2.151		

SUMMARIES.  
[Averages are per man per day.]

Period.	Nos. 1 and 4.										Nos. 1, 2, 4, 5, and 6.									
	Quantity.					Ratio.					Quantity.					Ratio.				
	Nitrogen.	Sulphur.	SO <sub>2</sub> .	P <sub>2</sub> O <sub>5</sub> .	S : N.	SO <sub>2</sub> : N.	P <sub>2</sub> O <sub>5</sub> : N.	S : N.	SO <sub>2</sub> : N.	P <sub>2</sub> O <sub>5</sub> : N.	Nitrogen.	Sulphur.	SO <sub>2</sub> .	P <sub>2</sub> O <sub>5</sub> .	S : N.	SO <sub>2</sub> : N.	P <sub>2</sub> O <sub>5</sub> : N.	S : N.	SO <sub>2</sub> : N.	P <sub>2</sub> O <sub>5</sub> : N.
<i>Fore period.</i>																				
First subperiod:	Grams.	Grams.	Grams.	Grams.	1 : 13.5	1 : 6.2	1 : 5.3				Grams.	Grams.	Grams.	Grams.	1 : 13.9	1 : 6.5	1 : 5.1			
Total	118.81	8.822	19.012	22.228							300.34	21.655	46.363	58.583						
Average	11.88	.882	1.901	2.228							12.01	.866	1.855	2.343						
Second subperiod:																				
Total	136.42	9.781	20.947	21.874	1 : 14.0	1 : 6.5	1 : 6.2				338.16	23.337	49.633	57.675	1 : 14.5	1 : 6.8	1 : 5.9			
Average	13.64	.978	2.095	2.187							13.53	.933	1.985	2.307						
Entire fore period:																				
Total	255.23	18.603	39.959	44.157	1 : 13.7	1 : 6.4	1 : 6.0				638.50	44.992	95.996	116.258	1 : 14.2	1 : 6.7	1 : 5.5			
Average	12.76	.930	1.998	2.208							12.77	.900	1.920	2.325						
<i>Preservative period.</i>																				
First subperiod:																				
Total	134.40	9.393	21.190	20.526	1 : 14.3	1 : 6.3	1 : 6.5				331.39	22.832	50.136	56.869	1 : 14.5	1 : 6.6	1 : 5.8			
Average	13.44	.939	2.119	2.053							13.26	.913	2.005	2.275						
Second subperiod:																				
Total	124.29	9.013	19.513	19.431	1 : 13.8	1 : 6.4	1 : 6.2				326.22	22.632	49.370	57.339	1 : 14.2	1 : 6.6	1 : 5.7			
Average	12.43	.901	1.951	1.943							13.05	.917	1.975	2.294						
Third subperiod:																				
Total	127.55	8.971	19.887	19.991	1 : 14.2	1 : 6.4	1 : 6.4				334.72	22.861	50.196	56.296	1 : 14.6	1 : 6.7	1 : 5.9			
Average	12.75	.897	1.989	1.999							13.39	.914	2.008	2.252						
Fourth subperiod:																				
Total	126.29	9.013	19.631	18.645	1 : 14.0	1 : 6.4	1 : 6.8													
Average	12.63	.901	1.963	1.865																
First, second, and third subperiods:																				
Total	512.51	36.390	80.221	79.093	1 : 14.1	1 : 6.4	1 : 6.5				992.33	68.625	149.702	170.504	1 : 14.5	1 : 6.6	1 : 5.8			
Average	12.81	.910	2.006	1.977							13.23	.915	1.996	2.273						
Entire preservative period:																				
Total	128.87	9.066	20.079	18.028	1 : 14.3	1 : 6.4	1 : 7.1				321.50	21.622	48.329	53.289	1 : 14.9	1 : 6.7	1 : 6.0			
Average	12.89	.901	2.008	1.803							12.86	.865	1.933	2.132						
Second subperiod:																				
Total	115.43	8.153	18.062	15.454	1 : 14.2	1 : 6.4	1 : 7.2				300.08	20.639	45.547	50.564	1 : 14.5	1 : 6.6	1 : 5.9			
Average	11.54	.815	1.806	1.595							12.00	.826	1.822	2.023						
Entire after period:																				
Total	244.30	17.129	38.141	33.982	1 : 14.2	1 : 6.4	1 : 7.2				621.58	42.281	93.876	103.853	1 : 14.7	1 : 6.6	1 : 6.0			
Average	12.22	.838	1.907	1.699							12.43	.846	1.878	2.077						
<i>After period.</i>																				
First subperiod:																				
Total	128.87	9.066	20.079	18.028	1 : 14.3	1 : 6.4	1 : 7.1				321.50	21.622	48.329	53.289	1 : 14.9	1 : 6.7	1 : 6.0			
Average	12.89	.901	2.008	1.803							12.86	.865	1.933	2.132						
Second subperiod:																				
Total	115.43	8.153	18.062	15.454	1 : 14.2	1 : 6.4	1 : 7.2				300.08	20.639	45.547	50.564	1 : 14.5	1 : 6.6	1 : 5.9			
Average	11.54	.815	1.806	1.595							12.00	.826	1.822	2.023						
Entire after period:																				
Total	244.30	17.129	38.141	33.982	1 : 14.2	1 : 6.4	1 : 7.2				621.58	42.281	93.876	103.853	1 : 14.7	1 : 6.6	1 : 6.0			
Average	12.22	.838	1.907	1.699							12.43	.846	1.878	2.077						

TABLE VIII.—*Urine determinations—Ratio of sulphur, sulphates, and phosphates to nitrogen, Series VIII—Continued.*  
 SUMMARIES—Continued.  
 [Averages are per man per day.]

Period.	Nos. 7 to 12.						Nos. 1 to 12 (omitting No. 3).					
	Quantity.			Ratio.			Quantity.			Ratio.		
	Nitrogen.	Sulphur.	SO <sub>3</sub> .	P <sub>2</sub> O <sub>5</sub> .	S : N.	SO <sub>3</sub> : N.	Nitrogen.	Sulphur.	SO <sub>3</sub> .	P <sub>2</sub> O <sub>5</sub> .	S : N.	SO <sub>3</sub> : N.
<i>Fore period.</i>												
First subperiod:												
Total.....	Grams. 374.39	Grams. 26.946	Grams. 57.825	Grams. 67.869	1:13.9	1:6.5	Grams. 674.73	Grams. 48.601	Grams. 104.188	Grams. 126.452	1:13.9	1:6.5
Average.....	12.48	.898	1.928	2.262	.....	.....	12.27	.884	1.894	2.269	.....	1:5.3
Second subperiod:												
Total.....	385.23	26.477	57.352	62.726	1:14.5	1:6.1	723.39	49.814	106.985	120.401	1:14.5	1:6.8
Average.....	12.84	.883	1.912	2.061	.....	.....	13.15	.906	1.945	2.189	.....	1:6.0
Entire fore period:												
Total.....	759.62	53.423	115.177	130.595	1:14.2	1:6.6	1,398.12	98.415	211.173	246.853	1:14.2	1:6.6
Average.....	12.66	.890	1.920	2.177	.....	.....	12.71	.895	1.920	2.244	.....	1:5.7
<i>Preservative period.</i>												
First subperiod:												
Total.....	419.82	28.826	63.138	68.513	1:14.6	1:6.6	751.21	51.658	113.274	125.352	1:14.5	1:6.6
Average.....	13.99	.961	2.105	2.284	.....	.....	13.66	.939	2.060	2.280	.....	1:6.0
Second subperiod:												
Total.....	384.01	26.478	58.185	63.777	1:14.5	1:6.6	710.23	49.410	107.555	121.116	1:14.4	1:6.6
Average.....	12.80	.883	1.940	2.126	.....	.....	12.91	.898	1.956	2.202	.....	1:5.9
Third subperiod:												
Total.....	398.81	27.045	59.290	60.744	1:14.7	1:6.7	733.53	49.906	109.486	117.040	1:14.7	1:6.7
Average.....	13.29	.902	1.976	2.025	.....	.....	13.34	.907	1.961	2.128	.....	1:6.3
First, second, and third sub- periods:												
Total.....	1,202.64	82.349	180.613	193.034	1:14.6	1:6.6	2,194.97	150.974	330.315	363.538	1:14.5	1:6.6
Average.....	13.36	.915	2.007	2.145	.....	.....	13.30	.915	2.002	2.203	.....	1:6.0
<i>After period.</i>												
First subperiod:												
Total.....	378.41	25.492	57.255	58.350	1:14.8	1:6.6	690.91	47.114	105.584	111.639	1:14.9	1:6.6
Average.....	12.61	.850	1.909	1.945	.....	.....	12.73	.857	1.920	2.030	.....	1:6.3
Second subperiod:												
Total.....	377.66	26.064	57.285	59.079	1:14.5	1:6.6	677.74	46.723	102.832	109.643	1:14.5	1:6.6
Average.....	12.59	.869	1.910	1.969	.....	.....	12.32	.850	1.870	1.994	.....	1:6.2
Entire after period:												
Total.....	756.07	51.556	114.540	117.429	1:14.7	1:6.6	1,377.65	93.837	208.416	221.282	1:14.7	1:6.6
Average.....	12.60	.859	1.909	1.957	.....	.....	12.52	.853	1.895	2.012	.....	1:6.2

# CHANGES IN THE RELATIVE QUANTITIES OF SULPHUR COMPOUNDS EXCRETED IN THE URINE.

The sulphur and the sulphur compounds, as in the previous experiments, were determined as follows: Total sulphur, which is entered as S and as  $\text{SO}_3$  in the table (Table IX), was determined by fusion with sodium peroxid. The total sulphates, which are entered in the table as  $\text{SO}_3$ , were determined by acidifying a sample of urine with hydrochloric acid, boiling and precipitating with barium chlorid. The ethereal sulphates were determined by precipitating the inorganic sulphates with a barium hydrate-barium chlorid solution, filtering and determining the ethereal sulphates in the filtrate. The neutral sulphur was calculated from the difference between the total sulphur as  $\text{SO}_3$  and the total sulphates. The inorganic sulphates represent the difference between the ethereal sulphates and the total sulphates. The ratio of the ethereal to the inorganic sulphates was obtained by dividing the latter by the former. The results are also expressed in percentage of total sulphur found in the urine in terms of  $\text{SO}_3$ .

## INDIVIDUAL DATA.

For No. 1 it is seen that 0.930 gram of sulphur is eliminated in the fore period, 0.946 gram in the preservative period, and 0.828 gram in the after period. The ingestion of sulphur in the food of No. 1, as shown in the balance sheets (Table XIV), is practically constant, being very little less in the preservative period than in the fore period and continuing to diminish slightly in the after period. It is, therefore, seen that there is an increased elimination of total sulphur during the preservative period which is not influenced in any way by the sulphur in the food. The neutral sulphur is diminished in the preservative period and continues to diminish in the after period, and the percentage excretion of neutral sulphur is 3.1 per cent less in the preservative period than in the fore period. The amount of total sulphates is slightly increased in the preservative period and diminished in the after period. The ethereal sulphates are practically constant throughout, being less in the after period than in the preservative or fore period. It is, therefore, seen that the increased elimination of sulphur is due to inorganic sulphates and this increase amounts to 0.112 gram daily in the preservative period, decreasing in the after period to an amount even less than in the fore period. The ratio of the ethereal sulphates to the inorganic sulphates is about normal in the fore period, being 1:10.7, and is slightly increased in the preservative and after periods, reaching 1:11.7 and 1:11.8, respectively.

For No. 2 the excretion of total sulphur is slightly increased during the preservative period, with a very slight decrease in the amount of sulphur in the food. The total sulphur returns to about the same



magnitude in the after period as in the fore period, with a considerable reduction of the sulphur ingested in the food. An inspection of the data for No. 2 in regard to the other forms of sulphur shows a decrease in the neutral sulphur throughout; an increase in the total sulphates in the preservative period and a slight decrease in the after period; a very slight increase in the ethereal sulphates throughout; and, as is to be expected, an increase in the amount of inorganic sulphates, which again shows the increased sulphur elimination to be in an inorganic form. The ratio of ethereal to inorganic sulphur is practically normal in the fore period, being 1:10.7, and is slightly increased in the preservative period, being 1:11; in the after period it returns to normal, namely, 1:10.4. The percentage figures show a diminution in the amount of neutral sulphur, the ethereal sulphates remaining the same, while there is an increase in the inorganic sulphates.

For No. 3 the elimination of total sulphur is practically the same in the fore and preservative periods with a diminution of 0.097 gram per day during the after period as compared with the fore period. The sulphur ingested in the food, on the other hand, is 0.102 gram per day less in the preservative period and rises to practically the same amount in the after period as in the fore period. The diminution, then, in the elimination of sulphur is partly offset by the decreased ingestion of sulphur in the food, but it is to be noted that the decrease in sulphur elimination does not accompany the decrease in the amount of sulphur ingested. The amount of neutral sulphur shows a gradually decreased elimination throughout the observation, falling to 0.156 gram per day in the after period, which is 0.168 gram less than the amount eliminated in the fore period. There is an increased amount of total sulphates eliminated in the preservative period. The ethereal sulphates remain constant throughout, and there is only a very slight change in the amount of inorganic sulphates eliminated. It is thus seen in the case of No. 3 that the change in the relation of the sulphur compounds is not so marked as in the cases of Nos. 1 and 2.

In the case of No. 4 there is a diminution of 0.057 gram per day of sulphur in the preservative period, which is slightly overcome in the after period. The ingestion of sulphur in the food is practically constant during the entire period of observation, though slightly less in the after period than in either of the other two. The neutral sulphur again shows a gradual diminution throughout, but not so marked as in the case of No. 3. The total sulphates are quite constant, being reduced only 0.092 gram per day in the preservative period and rising again in the after period to nearly the same magnitude as in the fore period. The ethereal sulphates are practically constant throughout. The amount of inorganic sulphates shows a diminution of 0.089 gram in the preservative period, rising in the after period to practically the

same amount as in the fore period. The ratio of ethereal sulphates to inorganic sulphates is 1:10.7 in the fore period, 1:10.4 in the preservative period, rising to 1:11.2 in the after period. There is a percentage diminution in the neutral sulphur and a corresponding increase in the total sulphates both in the preservative and after periods. The amount of ethereal sulphates, though smaller in actual amount, shows an increased percentage elimination in the preservative period of 0.3 per cent over that of the fore and after periods. The inorganic sulphates, expressed in percentage of the total sulphur eliminated, show an increase of 1 per cent and of 3 per cent in the preservative and after periods over the fore period.

There is very little change in the metabolism of sulphur for this subject, a slight tendency being shown to diminish the amount of total sulphur eliminated in the urine. Very little relative variation is shown in the different forms in which this sulphur is eliminated, the most marked change being again in the neutral sulphur, which is diminished throughout the observations.

There is an increased elimination of total sulphur in the case of No. 5 in the preservative period of 0.076 gram per day, returning in the after period to practically the same amount as in the fore period. There is an increased ingestion of food sulphur of 0.024 gram daily during the preservative period. Again it is seen that the amount of neutral sulphur gradually decreases throughout the period of observation; there is a marked increase in the quantity of total sulphates, and the ethereal sulphates remain practically constant throughout. As is plainly shown, the increased elimination of sulphur is due to the formation of inorganic sulphates. The ratio of ethereal sulphates to inorganic sulphates in the fore period is just a little below normal, being 1:9.2, and rising in the preservative period to 1:11. In the after period the ratio is 1:10.6. There is a decrease of 3.4 per cent in the neutral sulphur eliminated in the preservative period and a corresponding increase in the amount of total sulphates. The ethereal sulphates decrease 1 per cent in the preservative period, although the actual amount excreted is the same as in the fore period. There is an increased excretion of 4.4 per cent of inorganic sulphates over the fore period.

In the case of No. 6 there is a diminution of 0.047 gram per day of sulphur in the preservative period but a decrease of 0.066 gram per day in the amount of sulphur ingested in the food. In the after period the elimination is 0.111 gram per day less than in the fore period and the amount ingested 0.137 less. The amount of neutral sulphur gradually decreases throughout the observation; there is a diminution in the amount of total sulphates throughout, and also in the amount of ethereal sulphates which, however, is very slight. The inorganic sulphates also show a decreased elimination throughout, corresponding,

of course, to the change in total and ethereal sulphates. The ratio of ethereal to inorganic sulphates is 1 : 14.7 in the fore period, 1 : 15 in the preservative period, and 1 : 15.6 in the after period. Considering these figures alone, there is shown in this case a decreased elimination of sulphur. The decrease in the amount of sulphur ingested in the food, however, is even greater than the decrease in the amount excreted. The percentage amount of neutral sulphur excreted is slightly decreased throughout while the ethereal sulphates eliminated are practically constant. The percentage of total and inorganic sulphates is slightly increased throughout the observation.

There is a decreased elimination of total sulphur in the case of No. 7 throughout the observation, amounting to 0.059 gram per day in the preservative period and 0.140 gram per day in the after period as compared with the fore period. There is also a decrease throughout in the amount of sulphur ingested of about the same magnitude. Again, there is shown a diminished quantity of neutral sulphur excreted throughout the observation, and a decreased amount of ethereal sulphates which, in this case, is quite marked. The total sulphates show a gradual falling off throughout the observation, as do also the inorganic sulphates. The ratio of ethereal to inorganic sulphates is 1 : 14 in the fore period, 1 : 14.6 in the preservative period, and 1 : 15.1 in the after period. The neutral sulphur in the preservative period is 2.4 per cent less than in the fore period. The percentage of ethereal sulphates remains practically the same throughout, although the actual quantity is somewhat less in the two other periods than in the fore period. There is a corresponding increase to these amounts in the total sulphates and the inorganic sulphates. It is seen in the case of No. 7 that there is a diminished elimination of sulphur in the urine, but this is partly offset by the diminished amount of sulphur ingested during the observation.

The data for No. 8 show a slight gain of 0.012 gram per day in the total sulphur eliminated in the preservative period. The amount eliminated in the after period is almost exactly the same as in the fore period. The sulphur ingested in the food shows a gradual diminution throughout the observation, being 0.030 gram per day less in the preservative and 0.069 gram per day less in the after period than in the fore period. The neutral sulphur is quite markedly decreased in amount throughout, being just about one-half the quantity in the after period that it is in the fore period. The total sulphates show a gradual increase, the ethereal sulphates a decrease. Consequently it is in the amount of inorganic sulphates, in the case of No. 8, that the increased excretion of sulphur occurs. The figures expressing the ratio of the ethereal to the inorganic sulphates are 1 : 8.2, 1 : 9.6 and 1 : 10.3, respectively, for the three periods. Expressed in percentage of the total sulphur eliminated, the figures show a marked decrease in the pre-



servative period in the neutral sulphur eliminated, and a reduction in the ethereal sulphates of one per cent, while an increase occurs in the inorganic sulphates. There is evidence in this case of an increase in the sulphur excretion with marked changes in the forms in which it is eliminated in the urine.

In the case of No. 9 there is a slight increase throughout in the total sulphur eliminated, though the sulphur ingested in the food slightly decreases. The neutral sulphur is greater in the preservative period by 0.037 gram and less by 0.029 gram in the after period than in the fore period. The total sulphates show a slight diminution in the preservative period but are increased in the after period. The ethereal sulphates are practically the same throughout. The inorganic sulphates show very little change, being slightly less in the preservative period and increasing in the after period. The ratio of ethereal to inorganic sulphates is 1:13.2 in the fore period, 1:12.6 in the preservative period, and 1:13.0 in the after period. There is shown in this case a slight increase in the amount of sulphur eliminated, which differs from the previous data in that it is excreted in the neutral and organically combined form, whereas heretofore when there has been an increase, it is in the oxidized and inorganic form.

In the case of No. 10 there is practically no change in the amount of total sulphur excreted in the fore and preservative periods, while in the after period there is a decrease of 0.037 gram as compared with the amount in the fore period. There is a decrease of 0.037 gram in the amount of neutral sulphur in the preservative period and a still greater decrease in the after period. The ethereal sulphates are nearly constant in amount, while the inorganic sulphates show an increase in the preservative period, returning to practically the original figure in the after period. The ratios for the three periods are 1:11.0, 1:11.0, and 1:10.4, respectively. The percentage figures as well as those expressing actual amounts show that, considering the diminished amount of sulphur in the food, there is a small increase in the excretion of inorganic sulphur.

No. 11 shows an increased elimination of 0.058 gram per day of total sulphur during the preservative period and 0.049 gram during the after period as compared with the fore period. The sulphur ingested in the food gradually decreases throughout the observation. In this case there is a marked increase in the katabolic activities, at least, as regards the sulphur, which is even more pronounced when it is considered that the sulphur content of the food is diminished in about the same magnitude as the excretion is increased. The increase in sulphur, as in the majority of cases, is in the inorganic sulphates, which are increased 0.220 gram during the preservative period; in the after period there is a strong tendency shown to return to normal conditions. The ethereal sulphates in the case of No. 11 show an



increase during the preservative period of 0.016 gram and return to normal in the after period. The amount of neutral sulphur shows quite a decrease in the preservative period, rising to practically the same amount in the after period as in the fore period. The ratio of ethereal sulphates to inorganic sulphates is nearly twice the magnitude of the normal ratio and shows very little change, being 1: 18.7, 1: 18.1, and 1: 19.7, respectively, for the three periods. The percentage figures, showing relative amounts in terms of the total sulphur excreted, are in harmony with the figures showing the actual amounts present.

The data for No. 12 show an increased excretion of total sulphur of 0.051 gram per day during the preservative period with a decreased ingestion of 0.105 gram per day in the food. The amount of sulphur eliminated in the after period is less than in the fore period with a corresponding decrease in the amount of sulphur in the food. The neutral sulphur is diminished throughout as are the ethereal sulphates, the increase being entirely in the quantity of inorganic sulphates which show 0.152 gram more in the preservative period than in the fore period, but there is a decrease of 0.080 gram in the after period from the fore period. The results expressed in percentage show the same relative increase and decrease of the various forms as do the actual amounts.

#### SUMMARIES.

The summary for Nos. 1 and 4 is complete for the whole observation. This summary shows a decrease in the quantity of sulphur excreted in the preservative period and a still further decrease in the after period. The ratio of the ethereal to the inorganic sulphates is higher in the preservative period and still further increased in the after period. The ethereal sulphates and neutral sulphur decrease throughout the observation both in percentage and actual amount.

The summary for Nos. 1, 2, 4, 5, and 6, omitting the fourth preservative subperiod, shows a slight increase in the amount of total sulphur eliminated during the preservative period and a decrease during the after period. The sulphur ingested in the food slightly decreases throughout the observation.

In regard to the various forms in which this sulphur is eliminated, it is seen that there is quite a diminution in the neutral sulphur throughout, falling from 0.327 gram in the fore period to 0.289 gram in the preservative period and 0.238 gram in the after period. The ethereal sulphates are practically of the same magnitude (0.158 and 0.156 gram, respectively) in the fore and preservative periods, but fall to 0.148 gram in the after period. The increased excretion is due to the inorganic sulphates which amount to 1.762 grams in the fore period, 1.840 in the preservative period, and 1.729 in the after period.

The ratio is about normal and is 1: 11.1 in the fore period, 1: 11.8 in the preservative period, and 1: 11.7 in the after period. The same changes are shown by the figures expressing the relative percentage amounts of the different forms of sulphur for each period.

Taking the decrease in the amount of sulphur in the food into consideration, it is seen that there is a general tendency on the part of the preservative, benzoic acid, to increase the excretion of metabolized sulphur; individually this is shown in Nos. 1, 2, and 5, Nos. 4 and 6 showing a decrease during the preservative period. The decrease in food sulphur, however, in the case of No. 4 is practically the same as the decreased excretion, while for No. 6 the decrease in food sulphur is greater. Attention is called to the reduction of the neutral sulphur throughout the observation, which is uniformly shown for all the individuals of this summary. Another point is the remarkable constancy of the ethereal sulphates. The increased excretion of the sulphur is completely oxidized and excreted in an inorganic form which naturally slightly increases the ratio of the ethereal to the inorganic sulphates.

The next summary is for Nos. 7 to 12, who received benzoate of soda. There is a slightly larger increase in the excretion of sulphur for those taking the preservative in this form than for Nos. 1 to 6 (omitting No. 3), and there is also a decreased ingestion of sulphur throughout the entire observation. The neutral sulphur is decreased throughout, and the ethereal sulphates again remain constant during the fore and preservative periods with a slight decrease during the after period. The inorganic sulphates are increased 0.090 gram during the preservative period, as compared with 0.078 gram increase in the summary for Nos. 1, 2, 4, 5, and 6, and return to practically the same amount in the after period as in the fore period. The ratio is slightly larger than in the benzoic acid summary and is largest in the after period.

The same trend in the percentage excretion is shown in both summaries, with the exception of the ethereal sulphates in the after period which continues to be decreased in the sodium benzoate summary (Nos. 7 to 12) and is returned to normal in the benzoic acid summary. In general, it is quite noticeable that there is practically no difference in the effect produced by benzoic acid and sodium benzoate on the excretion of sulphur in the urine. This is further shown by inspection of the data in the summary for Nos. 1 to 12, the data being merely combined in one expression. These figures show the general effect of this preservative in its two forms on the excretion of sulphur.

It is quite evident that there is a slight tendency manifested to increase the katabolic activities, as shown by the increased excretion

of metabolized sulphur, which is more pronounced when the diminution in the amount of sulphur in the food is taken into consideration. There is a reduction in the amount of neutral sulphur eliminated under the influence of the preservatives and this diminution is increased in the after period.

The average increased excretion of total sulphates during the preservative period is 0.082 gram per day, which is entirely in the form of inorganic sulphates, as the ethereal sulphates are practically of the same magnitude in the fore and preservative periods. From this it is quite evident that there is a marked tendency, as is shown by the sulphur and sulphate excretion, to increase katabolic activities, at least during the administration of the preservative. Considered in connection with the decrease in body weight, this point becomes more significant.

Another point worthy of mention in this discussion is the constancy of the ethereal sulphates. These organically combined sulphates are regarded as an index to putrefactive changes in the intestines due to proteid decomposition. The average elimination for the 11 men is as follows: Fore period, 0.157; preservative period, 0.154, and after period, 0.143.

It is evident, therefore, that the administration of benzoic acid and benzoates has practically no effect on the excretion of the ethereal sulphates. This condition may be accounted for in two ways. The preservative may be broken up or absorbed, the aromatic nucleus being taken up by the glycocoll in the body, and therefore it does not reach that part of the intestinal canal where the ethereal sulphates are formed, or it may in part reach the lower intestines where the reduction in these sulphates caused by the antiseptic action of the preservative is offset by the increase due to the combination with the benzene nucleus. From the uniform manner in which these aromatic sulphates are excreted, it would seem that the first explanation is more plausible and that the excretion of ethereal sulphates is, therefore, maintained under nearly normal conditions.



TABLE IX.—*Urine determinations—Ratio of preformed sulphates to ethereal sulphates and neutral sulphur, Series VIII.*

[Averages are per day.]

## No. 1.

Period.	Total sulphur as S.	Total sulphur as SO <sub>3</sub> .	Neutral sulphur as SO <sub>3</sub> .	Total sulphates as SO <sub>3</sub> .	Ethereal sulphates as SO <sub>3</sub> .	Inorganic sulphates as SO <sub>3</sub> .	Ratio of ethereal to inorganic sulphates.	Results expressed in per cent of total sulphur in terms of SO <sub>3</sub> .			
								Neutral sulphur.	Total sulphates.	Ethereal sulphates.	Inorganic sulphates.
<i>Fore period.</i>											
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>		<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
Total.....	4.431	11.064	1.634	9.430	0.784	8.646	1:11.0	14.8	85.2	7.1	78.1
Average.....	.886	2.213	.327	1.886	.157	1.729					
Second subperiod:											
Total.....	4.867	12.153	1.836	10.317	.906	9.411	1:10.4	15.1	84.9	7.5	77.4
Average.....	.973	2.431	.367	2.063	.181	1.882					
Entire fore period:											
Total.....	9.298	23.217	3.470	19.747	1.690	18.057	1:10.7	14.9	85.1	7.3	77.8
Average.....	.930	2.322	.347	1.975	.169	1.806					
<i>Preservative period.</i>											
First subperiod:											
Total.....	4.730	11.812	1.092	10.720	.815	9.905	1:12.2	9.2	90.8	6.9	83.9
Average.....	.946	2.362	.218	2.144	.163	1.981					
Second subperiod:											
Total.....	4.735	11.823	1.744	10.079	.805	9.274	1:11.5	14.8	85.2	6.8	78.4
Average.....	.947	2.365	.349	2.016	.161	1.855					
Third subperiod:											
Total.....	4.767	11.904	1.346	10.558	.844	9.714	1:11.5	11.3	88.7	7.1	81.6
Average.....	.953	2.381	.269	2.112	.169	1.943					
Fourth subperiod:											
Total.....	4.678	11.681	1.390	10.291	.822	9.469	1:11.5	11.9	88.1	7.0	81.1
Average.....	.936	2.336	.278	2.058	.164	1.894					
Entire preservative period:											
Total.....	18.910	47.220	5.572	41.648	3.286	38.362	1:11.7	11.8	88.2	7.0	81.2
Average.....	.946	2.361	.279	2.082	.164	1.918					
<i>After period.</i>											
First subperiod:											
Total.....	4.311	10.765	1.279	9.486	.709	8.777	1:12.4	11.9	88.1	6.6	81.5
Average.....	.862	2.153	.256	1.897	.142	1.755					
Second subperiod:											
Total.....	3.973	9.920	1.205	8.715	.708	8.007	1:11.3	12.1	87.9	7.1	80.7
Average.....	.795	1.984	.241	1.743	.142	1.601					
Entire after period:											
Total.....	8.284	20.685	2.484	18.201	1.417	16.784	1:11.8	12.0	88.0	6.9	81.1
Average.....	.828	2.069	.248	1.820	.142	1.678					



TABLE IX.—*Urine determinations—Ratio of preformed sulphates to ethereal sulphates and neutral sulphur, Series VIII—Continued.*

[Averages are per day.]

## No. 2.

Period.	Total sulphur as S.	Total sulphur as SO <sub>3</sub> .	Neutral sulphur as SO <sub>3</sub> .	Total sulphates as SO <sub>3</sub> .	Ethereal sulphates as SO <sub>3</sub> .	Inorganic sulphates as SO <sub>3</sub> .	Ratio of ethereal to inorganic sulphates.	Results expressed in per cent of total sulphur in terms of SO <sub>3</sub> .			
								Neutral sulphur.	Total sulphates.	Ethereal sulphates.	Inorganic sulphates.
<i>Fore period.</i>											
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>					
Total .....	5.248	13.105	1.910	11.195	0.956	10.239	1:10.7	14.6	85.4	7.3	78.1
Average .....	1.050	2.621	.382	2.239	.191	2.048					
Second subperiod:											
Total .....	6.086	15.197	2.305	12.892	1.094	11.798	1:10.8	15.2	84.8	7.2	77.6
Average .....	1.217	3.039	.461	2.578	.219	2.360					
Entire fore period:											
Total .....	11.334	28.302	4.215	24.087	2.050	22.037	1:10.7	14.9	85.1	7.2	77.9
Average .....	1.133	2.830	.422	2.409	.205	2.204					
<i>Preservative period.</i>											
First subperiod:											
Total .....	5.987	14.951	2.124	12.827	.833	11.994	1:14.4	14.2	85.8	5.6	80.2
Average .....	1.197	2.990	.425	2.565	.167	2.399					
Second subperiod:											
Total .....	5.968	14.902	2.181	12.721	1.137	11.584	1:10.2	14.6	85.4	7.6	77.7
Average .....	1.194	2.980	.436	2.544	.227	2.317					
Third subperiod:											
Total .....	5.950	14.856	1.951	12.905	1.130	11.775	1:10.4	13.1	86.9	7.6	79.3
Average .....	1.190	2.971	.390	2.581	.226	2.355					
Fourth subperiod:											
Total .....	5.737	14.324	2.022	12.302	1.144	11.158	1: 9.8	14.1	85.9	8.0	77.9
Average .....	1.147	2.865	.404	2.460	.229	2.232					
Entire preservative period:											
Total .....	23.642	59.033	8.278	50.755	4.244	46.511	1:11.0	14.0	86.0	7.2	78.8
Average .....	1.182	2.952	.414	2.538	.212	2.326					
<i>After period.</i>											
First subperiod:											
Total .....	5.545	13.845	1.573	12.272	1.137	11.135	1: 9.8	11.4	88.6	8.2	80.4
Average .....	1.109	2.769	.315	2.454	.227	2.227					
Second subperiod:											
Total .....	5.616	14.024	1.741	12.283	1.022	11.261	1:11.0	12.4	87.6	7.3	80.3
Average .....	1.123	2.805	.348	2.457	.204	2.252					
Entire after period:											
Total .....	11.161	27.869	3.314	24.555	2.159	22.396	1:10.4	11.9	88.1	7.7	80.4
Average .....	1.116	2.787	.331	2.456	.216	2.240					

TABLE IX.—*Urine determinations—Ratio of preformed sulphates to ethereal sulphates and neutral sulphur, Series VIII—Continued.*

[Averages are per day.]

## No. 3.

Period.	Total sulphur as S.	Total sulphur as SO <sub>3</sub> .	Neutral sulphur as SO <sub>3</sub> .	Total sulphates as SO <sub>3</sub> .	Ethereal sulphates as SO <sub>3</sub> .	Inorganic sulphates as SO <sub>3</sub> .	Ratio of ethereal to inorganic sulphate.	Results expressed in per cent of total sulphur in terms of SO <sub>3</sub> .			
								Neutral sulphur.	Total sulphates.	Ethereal sulphates.	Inorganic sulphates.
<i>Fore period.</i>											
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>		<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
Total.....	5.027	12.552	1.547	11.005	0.714	10.291	1:14.4	12.3	87.7	5.7	82.0
Average.....	1.005	2.510	.309	2.201	.143	2.058					
Second subperiod:											
Total.....	4.986	12.450	1.696	10.754	.776	9.978	1:12.9	13.6	86.4	6.2	80.1
Average.....	.997	2.490	.339	2.151	.155	1.996					
Entire fore period:											
Total.....	10.013	25.002	3.243	21.759	1.490	20.269	1:13.6	13.0	87.0	6.0	81.1
Average.....	1.001	2.500	.324	2.176	.149	2.027					
<i>Preservative period.</i>											
First subperiod:											
Total.....	5.224	13.044	1.416	11.628	.769	10.859	1:14.1	10.9	89.1	5.9	83.2
Average.....	1.045	2.609	.283	2.326	.154	2.172					
Second subperiod:											
Total.....	5.124	12.795	1.472	11.323	.730	10.593	1:14.5	11.5	88.5	5.7	82.8
Average.....	1.025	2.559	.294	2.265	.146	2.119					
Third subperiod:											
Total.....	4.939	12.332	1.521	10.811	.693	10.118	1:14.6	12.3	87.7	5.6	82.0
Average.....	.988	2.466	.304	2.162	.139	2.024					
Fourth subperiod:											
Total.....	4.607	11.504	1.268	10.236	.696	9.540	1:13.7	11.0	89.0	6.1	82.9
Average.....	.921	2.301	.254	2.047	.139	1.908					
Entire preservative period:											
Total.....	19.894	49.675	5.677	43.998	2.888	41.110	1:14.2	11.4	88.6	5.8	82.8
Average.....	.995	2.484	.284	2.200	.144	2.056					
<i>After period.</i>											
First subperiod:											
Total.....	4.602	11.492	.516	10.976	.770	10.206	1:13.3	4.5	95.5	6.7	88.8
Average.....	.920	2.298	.103	2.195	.154	2.041					
Second subperiod:											
Total.....	4.437	11.079	1.047	10.032	.700	9.332	1:13.3	9.5	90.6	6.3	84.2
Average.....	.887	2.216	.209	2.006	.140	1.866					
Entire after period:											
Total.....	9.039	22.571	1.563	21.008	1.470	19.538	1:13.3	6.9	93.1	6.5	86.6
Average.....	.904	2.257	.156	2.101	.147	1.954					

TABLE IX.—*Urine determinations—Ratio of preformed sulphates to ethereal sulphates and neutral sulphur, Series VIII—Continued.*

[Averages are per day.]

## No. 4.

Period.	Total sulphur as S.	Total sulphur as SO <sub>3</sub> .	Neutral sulphur as SO <sub>3</sub> .	Total sulphates as SO <sub>3</sub> .	Ethereal sulphates as SO <sub>3</sub> .	Inorganic sulphates as SO <sub>3</sub> .	Ratio of ethereal to inorganic sulphates.	Results expressed in per cent of total sulphur in terms of SO <sub>3</sub> .			
								Neutral sulphur.	Total sulphates.	Ethereal sulphates.	Inorganic sulphates.
<i>Fore period.</i>											
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>		<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
Total.....	4.391	10.964	1.382	9.582	0.799	8.783	1:11.0	12.6	87.4	7.3	80.1
Average.....	.878	2.193	.276	1.916	.160	1.757					
Second subperiod:											
Total.....	4.914	12.271	1.641	10.630	.926	9.704	1:10.3	13.4	86.6	7.5	79.1
Average.....	.983	2.454	.328	2.126	.185	1.941					
Entire fore period:											
Total.....	9.305	23.235	3.023	20.212	1.725	18.487	1:10.7	13.0	87.0	7.4	79.6
Average.....	.931	2.324	.302	2.021	.173	1.849					
<i>Preservative period.</i>											
First subperiod:											
Total.....	4.663	11.644	1.174	10.470	.805	9.665	1:12.0	10.1	89.9	6.9	83.0
Average.....	.933	2.329	.235	2.094	.161	1.933					
Second subperiod:											
Total.....	4.278	10.681	1.247	9.434	.887	8.547	1: 9.6	11.7	88.3	8.3	80.0
Average.....	.856	2.136	.249	1.887	.177	1.709					
Third subperiod:											
Total.....	4.204	10.497	1.168	9.329	.825	8.504	1:10.3	11.1	88.9	7.9	81.0
Average.....	.841	2.099	.234	1.866	.165	1.701					
Fourth subperiod:											
Total.....	4.335	10.824	1.484	9.340	.862	8.478	1: 9.8	13.7	86.3	8.0	78
Average.....	.867	2.165	.297	1.868	.172	1.696					
Entire preservative period:											
Total.....	17.480	43.646	5.073	38.573	3.379	35.194	1:10.4	11.6	88.4	7.7	80.6
Average.....	.874	2.182	.254	1.929	.169	1.760					
<i>After period.</i>											
First subperiod:											
Total.....	4.695	11.723	1.130	10.593	.873	9.720	1:11.1	9.6	90.4	7.4	82.9
Average.....	.939	2.345	.226	2.119	.175	1.944					
Second subperiod:											
Total.....	4.180	10.438	1.091	9.347	.764	8.583	1:11.2	10.5	89.5	7.3	82.2
Average.....	.836	2.088	.218	1.869	.153	1.717					
Entire after period:											
Total.....	8.875	22.161	2.221	19.940	1.637	18.303	1:11.2	10.0	90.0	7.4	82.6
Average.....	.888	2.216	.222	1.994	.164	1.830					

TABLE IX.—*Urine determinations—Ratio of preformed sulphates to ethereal sulphates and neutral sulphur, Series VIII—Continued.*

[Averages are per day.]

No. 5.

Period.	Total sulphur as S.	Total sulphur as SO <sub>3</sub> .	Neutral sulphur as SO <sub>3</sub> .	Total sulphates as SO <sub>3</sub> .	Ethereal sulphates as SO <sub>3</sub> .	Inorganic sulphates as SO <sub>3</sub> .	Ratio of ethereal to inorganic sulphates.	Results expressed in per cent of total sulphur in terms of SO <sub>3</sub> .			
								Neutral sulphur.	Total sulphates.	Ethereal sulphates.	Inorganic sulphates.
<i>Fore period.</i>											
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>		<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
Total.....	<sup>a</sup> 2.915	7.279	1.078	6.201	0.585	5.616	1:9.6	14.8	85.2	8.0	77.1
Average.....	.583	1.456	.216	1.240	.117	1.123					
Second subperiod:											
Total.....	2.820	7.042	1.153	5.889	.602	5.287	1:8.8	16.4	83.6	8.5	75.1
Average.....	.564	1.408	.231	1.178	.120	1.057					
Entire fore period:											
Total.....	<sup>a</sup> 5.735	14.321	2.231	12.090	1.187	10.903	1:9.2	15.6	84.4	8.3	76.1
Average.....	.574	1.432	.223	1.209	.119	1.090					
<i>Preservative period.</i>											
First subperiod:											
Total.....	3.078	7.686	1.040	6.646	.576	6.070	1:10.5	13.5	86.5	7.5	79.0
Average.....	.616	1.537	.208	1.329	.115	1.214					
Second subperiod:											
Total.....	<sup>a</sup> 3.421	8.542	1.201	7.341	.598	6.743	1:11.3	14.1	85.9	7.0	78.9
Average.....	.684	1.708	.240	1.468	.120	1.349					
Third subperiod:											
Total.....	3.431	8.566	.838	7.728	.662	7.066	1:10.7	9.8	90.2	7.7	82.5
Average.....	.686	1.713	.168	1.546	.132	1.413					
Fourth subperiod:											
Total.....	<sup>a</sup> 3.066	7.656	.877	6.779	.534	6.245	1:11.7	11.5	88.5	7.0	81.6
Average.....	.613	1.531	.175	1.356	.107	1.249					
Entire preservative period:											
Total.....	12.996	32.450	3.956	28.494	2.370	26.124	1:11.0	12.2	87.8	7.3	80.5
Average.....	.650	1.623	.198	1.425	.119	1.306					
<i>After period.</i>											
First subperiod:											
Total.....	<sup>a</sup> 2.953	7.374	.761	6.613	.571	6.042	1:10.6	10.3	89.7	7.7	81.9
Average.....	.591	1.475	.152	1.323	.114	1.208					
Second subperiod:											
Total.....	2.802	6.997	1.023	5.974	.515	5.459	1:10.6	14.6	85.4	7.4	78.0
Average.....	.560	1.399	.205	1.195	.103	1.092					
Entire after period:											
Total.....	5.755	14.371	1.784	12.587	1.086	11.501	1:10.6	12.4	87.6	7.6	80.0
Average.....	.576	1.437	.178	1.259	.109	1.150					

<sup>a</sup> Average added to complete record.



TABLE IX.—*Urine determinations—Ratio of preformed sulphates to ethereal sulphates and neutral sulphur, Series VIII—Continued.*

[Averages are per day.]

## No. 6.

Period.	Total sulphur as S.	Total sulphur as SO <sub>2</sub> .	Neutral sulphur as SO <sub>2</sub> .	Total sulphates as SO <sub>2</sub> .	Ethereal sulphates as SO <sub>2</sub> .	Inorganic sulphates as SO <sub>2</sub> .	Ratio of ethereal to inorganic sulphates.	Results expressed in per cent of total sulphur in terms of SO <sub>2</sub> .			
								Neutral sulphur.	Total sulphates.	Ethereal sulphates.	Inorganic sulphates.
<i>Fore period.</i>											
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>		<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
Total.....	4.670	11.662	1.710	9.952	0.627	9.325	1: 14.9	14.7	85.3	5.4	80.0
Average.....	.934	2.332	.342	1.990	.125	1.865					
Second subperiod:											
Total.....	4.650	11.610	1.705	9.905	.638	9.267	1: 14.5	14.7	85.3	5.5	79.8
Average.....	.930	2.322	.341	1.981	.128	1.853					
Entire fore period:											
Total.....	9.320	23.272	3.415	19.857	1.265	18.592	1: 14.7	14.7	85.3	5.4	79.9
Average.....	.932	2.327	.342	1.986	.127	1.859					
<i>Preservative period:</i>											
First subperiod:											
Total.....	4.374	10.922	1.449	9.473	.590	8.883	1: 15.1	13.3	86.7	5.4	81.3
Average.....	.875	2.184	.290	1.895	.118	1.777					
Second subperiod:											
Total.....	4.530	11.310	1.515	9.795	.609	9.186	1: 15.1	14.6	86.6	5.4	81.2
Average.....	.906	2.262	.303	1.959	.122	1.837					
Third subperiod:											
Total.....	4.509	11.259	1.583	9.676	.606	9.070	1: 15.0	14.1	85.9	5.4	80.6
Average.....	.902	2.252	.317	1.935	.121	1.814					
Fourth subperiod:											
Total.....	4.289	10.709	1.359	9.350	.582	8.768	1: 15.1	12.7	87.3	5.4	81.9
Average.....	.858	2.142	.272	1.870	.116	1.754					
Entire preservative period:											
Total.....	17.702	44.200	5.906	38.294	2.387	35.907	1: 15.0	13.4	86.6	5.4	81.2
Average.....	.885	2.210	.295	1.915	.119	1.795					
<i>After period.</i>											
First subperiod:											
Total.....	4.118	10.282	.916	9.366	.571	8.795	1: 15.4	8.9	91.1	5.6	85.5
Average.....	.824	2.056	.183	1.873	.114	1.759					
Second subperiod:											
Total.....	<sup>a</sup> 4.080	10.210	.981	9.229	.549	8.680	1: 15.8	9.6	90.4	5.4	85.0
Average.....	.818	2.042	.196	1.846	.110	1.736					
Entire after period:											
Total.....	8.207	20.492	1.897	18.595	1.120	17.475	1: 15.6	9.3	90.7	5.5	85.3
Average.....	.821	2.049	.190	1.860	.112	1.748					

<sup>a</sup> Average added to complete record.

TABLE IX.—*Urine determinations—Ratio of preformed sulphates to ethereal sulphates and neutral sulphur, Series VIII—Continued.*

[Averages are per day.]

No. 7.

Period.	Total sulphur as S.	Total sulphur as SO <sub>3</sub> .	Neutral sulphur as SO <sub>2</sub> .	Total sulphates as SO <sub>3</sub> .	Ethereal sulphates as SO <sub>3</sub> .	Inorganic sulphates as SO <sub>3</sub> .	Ratio of ethereal to inorganic sulphates.	Results expressed in per cent of total sulphur in terms of SO <sub>3</sub> .			
								Neutral sulphur.	Total sulphates.	Ethereal sulphates.	Inorganic sulphates.
<i>Fore period.</i>											
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>		<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
Total.....	4.423	11.044	1.455	9.589	0.622	8.967	1:14.4	13.2	86.8	5.6	81.2
Average.....	.885	2.209	.291	1.918	.124	1.793					
Second subperiod:											
Total.....	4.576	11.427	1.908	9.519	.648	8.871	1:13.7	16.7	83.3	5.7	77.6
Average.....	.915	2.285	.382	1.904	.130	1.774					
Entire fore period:											
Total.....	8.999	22.471	3.363	19.108	1.270	17.838	1:14.0	15.0	85.0	5.7	80.3
Average.....	.900	2.247	.336	1.911	.127	1.784					
<i>Preservative period.</i>											
First subperiod:											
Total.....	4.564	11.397	1.500	9.897	.598	9.299	1:15.5	13.2	86.8	5.2	81.6
Average.....	.913	2.279	.300	1.979	.120	1.860					
Second subperiod:											
Total.....	3.987	9.956	1.270	8.686	.588	8.098	1:13.8	12.8	87.2	5.9	81.3
Average.....	.797	1.991	.254	1.737	.118	1.620					
Third subperiod:											
Total.....	3.796	9.178	1.108	8.370	.565	7.805	1:13.8	11.7	88.3	6.0	82.3
Average.....	.759	1.896	.222	1.674	.113	1.561					
Fourth subperiod:											
Total.....	4.464	11.146	1.425	9.721	.603	9.118	1:15.1	12.8	87.2	5.4	81.8
Average.....	.893	2.229	.285	1.944	.121	1.824					
Entire preservative period:											
Total.....	16.811	41.977	5.303	36.674	2.354	34.320	1:14.6	12.6	87.4	5.6	81.8
Average.....	.841	2.099	.265	1.834	.118	1.716					
<i>After period.</i>											
First subperiod:											
Total.....	3.603	8.997	1.054	7.943	.516	7.427	1:14.4	11.7	88.3	5.7	82.5
Average.....	.721	1.799	.211	1.589	.103	1.485					
Second subperiod:											
Total.....	3.996	9.978	1.489	8.489	.505	7.984	1:15.8	14.9	85.1	5.1	80.0
Average.....	.799	1.996	.298	1.698	.101	1.597					
Entire after period:											
Total.....	7.599	18.975	2.543	16.432	1.021	15.411	1:15.1	13.4	86.6	5.4	81.2
Average.....	.760	1.898	.254	1.643	.102	1.541					

TABLE IX.—*Urine determinations—Ratio of preformed sulphates to ethereal sulphates and neutral sulphur, Series VIII—Continued.*

[Averages are per day.]

No. 8.

Period.	Total sulphur as S.	Total sulphur as SO <sub>3</sub> .	Neutral sulphur as SO <sub>3</sub> .	Total sulphates as SO <sub>3</sub> .	Ethereal sulphates as SO <sub>3</sub> .	Inorganic sulphates as SO <sub>3</sub> .	Ratio of ethereal to inorganic sulphates.	Results expressed in per cent of totalsulphur in terms of SO <sub>3</sub> .			
								Neutral sulphur.	Total sulphates.	Ethereal sulphates.	Inorganic sulphates.
<i>Fore period.</i>											
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>		<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P.ct.</i>
Total.....	4.133	10.319	1.701	8.618	0.884	7.734	1:8.7	16.5	83.5	8.6	74.9
Average.....	.827	2.064	.340	1.724	.177	1.547					
Second subperiod:											
Total.....	4.132	10.317	1.416	8.901	1.012	7.889	1:7.8	13.7	86.3	9.8	76.5
Average.....	.826	2.063	.283	1.780	.202	1.578					
Entire fore period:											
Total.....	8.265	20.636	3.117	17.519	1.896	15.623	1:8.2	15.1	84.9	9.2	75.7
Average.....	.827	2.064	.312	1.752	.190	1.562					
<i>Preservative period.</i>											
First subperiod:											
Total.....	4.373	10.920	1.637	9.283	.895	8.388	1:9.4	15.0	85.0	8.2	76.8
Average.....	.875	2.184	.327	1.857	.179	1.678					
Second subperiod:											
Total.....	<sup>a</sup> 4.253	10.620	1.454	9.166	.745	8.421	1:9.4	13.7	86.3	7.0	79.3
Average.....	.851	2.124	.291	1.833	.149	1.684					
Third subperiod:											
Total.....	4.113	10.271	1.406	8.865	.823	8.042	1:9.8	13.7	86.3	8.0	78.3
Average.....	.823	2.054	.281	1.773	.165	1.608					
Fourth subperiod:											
Total.....	4.047	10.105	1.158	8.947	.967	7.980	1:9.7	11.5	88.5	9.6	79.0
Average.....	.809	2.021	.232	1.789	.193	1.596					
Entire preservative period:											
Total.....	16.786	41.916	5.655	36.261	3.430	32.831	1:9.6	13.5	86.5	8.2	78.3
Average.....	.839	2.066	.283	1.813	.172	1.642					
<i>After period.</i>											
First subperiod:											
Total.....	4.074	10.173	.704	9.469	.860	8.609	1:10.0	6.9	93.1	8.5	85.4
Average.....	.815	2.035	.141	1.894	.172	1.722					
Second subperiod:											
Total.....	4.182	10.443	.899	9.544	.821	8.723	1:10.6	8.6	91.4	7.9	83.5
Average.....	.836	2.089	.180	1.909	.164	1.745					
Entire after period:											
Total.....	8.256	20.616	1.603	19.013	1.681	17.332	1:10.3	7.8	92.2	8.2	84.1
Average.....	.826	2.062	.160	1.901	.168	1.733					

<sup>a</sup> Average added to complete record.



TABLE IX.—Urine determinations—Ratio of preformed sulphates to ethereal sulphates and neutral sulphur, Series VIII—Continued.

[Averages are per day.]

No. 9.

Period.	Total sulphur as S.	Total sulphur as SO <sub>3</sub> .	Neutral sulphur as SO <sub>3</sub> .	Total sulphates as SO <sub>3</sub> .	Ethereal sulphates as SO <sub>3</sub> .	Inorganic sulphates as SO <sub>3</sub> .	Ratio of ethereal to inorganic sulphates.	Results expressed in per cent of total sulphur in terms of SO <sub>3</sub> .			
								Neutral sulphur.	Total sulphates.	Ethereal sulphates.	Inorganic sulphates.
<i>Fore period.</i>											
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>		<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
Total	4.833	12.068	1.197	10.871	0.748	10.123	1:13.5	9.9	90.1	6.2	83.9
Average	.967	2.414	.239	2.174	.150	2.025					
Second subperiod:											
Total	4.753	11.869	1.202	10.667	.765	9.902	1:12.9	10.1	89.9	6.4	83.4
Average	.951	2.374	.240	2.133	.153	1.980					
Entire fore period:											
Total	9.586	23.937	2.399	21.538	1.513	20.025	1:13.2	10.0	90.0	6.3	83.7
Average	.959	2.394	.240	2.154	.151	2.003					
<i>Preservative period.</i>											
First subperiod:											
Total	<sup>a</sup> 4.860	12.135	1.402	10.733	.789	9.944	1:12.6	11.6	88.4	6.5	81.9
Average	.972	2.427	.280	2.147	.158	1.989					
Second subperiod:											
Total	4.464	11.147	1.166	9.981	.718	9.263	1:12.9	10.5	89.5	6.4	83.1
Average	.893	2.229	.233	1.996	.144	1.853					
Third subperiod:											
Total	5.219	13.032	1.582	11.450	.866	10.584	1:12.2	12.1	87.9	6.6	81.2
Average	1.044	2.606	.316	2.290	.173	2.117					
First, second, and third subperiods:											
Total	14.543	36.314	4.150	32.164	2.373	29.791	1:12.6	11.4	88.6	6.5	82.0
Average	.970	2.421	.277	2.144	.158	1.986					
<i>After period.</i>											
First subperiod:											
Total	4.919	12.282	1.334	10.928	.774	10.154	1:13.1	11.0	89.0	6.3	82.7
Average	.984	2.456	.271	2.186	.155	2.031					
Second subperiod:											
Total	4.810	12.010	.757	11.253	.810	10.443	1:12.9	6.3	93.7	6.7	87.0
Average	.962	2.402	.151	2.251	.162	2.089					
Entire after period:											
Total	9.729	24.292	2.111	22.181	1.584	20.597	1:13.0	8.7	91.3	6.5	84.8
Average	.973	2.429	.211	2.218	.158	2.060					

<sup>a</sup> Average added to complete record.

TABLE IX.—*Urine determinations—Ratio of preformed sulphates to etheral sulphates and neutral sulphur, Series VIII—Continued.*

[Averages are per day.]

## No. 10.

Period.	Total sulphur as S.	Total sulphur as SO <sub>3</sub> .	Neutral sulphur as SO <sub>3</sub> .	Total sulphates as SO <sub>3</sub> .	Etheral sulphates as SO <sub>3</sub> .	Inorganic sulphates as SO <sub>3</sub> .	Ratio of etheral to inorganic sulphates.	Results expressed in per cent of total sulphur in terms of SO <sub>3</sub> .			
								Neutral sulphur.	Total sulphates.	Etheral sulphates.	Inorganic sulphates.
<i>Fore period.</i>											
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>		<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P.ct.</i>
Total.....	3.861	9.641	1.483	8.158	0.661	7.497	1:11.3	15.4	84.6	6.9	77.8
Average.....	.772	1.928	.297	1.632	.132	1.499					
Second subperiod:											
Total.....	3.842	9.594	1.331	8.263	.713	7.550	1:10.6	13.9	86.1	7.4	78.7
Average.....	.768	1.919	.266	1.653	.143	1.510					
Entire fore period:											
Total.....	7.703	19.235	2.814	16.421	1.374	15.047	1:11.0	14.6	85.4	7.1	78.2
Average.....	.770	1.924	.281	1.642	.137	1.505					
<i>Preservative period.</i>											
First subperiod:											
Total.....	4.394	10.971	1.280	9.691	.779	8.912	1:11.4	11.7	88.3	7.1	81.2
Average.....	.879	2.194	.256	1.938	.156	1.782					
Second subperiod:											
Total.....	4.236	10.577	1.248	9.329	.753	8.576	1:11.4	11.8	88.2	7.1	81.1
Average.....	.847	2.115	.250	1.866	.151	1.715					
Third subperiod:											
Total.....	3.555	8.877	1.268	7.609	.664	6.945	1:10.5	14.3	85.7	7.5	78.2
Average.....	.711	1.775	.254	1.522	.133	1.389					
Fourth subperiod:											
Total.....	3.244	8.100	1.092	7.008	.613	6.395	1:10.4	13.5	86.5	7.6	79.0
Average.....	.649	1.620	.218	1.402	.123	1.279					
Entire preservative period:											
Total.....	15.429	38.525	4.888	33.637	2.809	30.828	1:11.0	12.7	87.3	7.3	80.0
Average.....	.771	1.926	.244	1.682	.140	1.541					
<i>After period.</i>											
First subperiod:											
Total.....	3.674	9.174	.572	8.602	.732	7.870	1:10.8	6.2	93.8	8.0	85.8
Average.....	.735	1.835	.114	1.720	.146	1.574					
Second subperiod:											
Total.....	3.654	9.124	1.166	7.958	.724	7.234	1:10.0	12.8	87.2	7.9	79.3
Average.....	.731	1.825	.233	1.592	.145	1.447					
Entire after period:											
Total.....	7.328	18.298	1.738	16.560	1.456	15.104	1:10.4	9.5	90.5	8.0	82.5
Average.....	.733	1.830	.174	1.656	.146	1.510					



TABLE IX.—*Urine determinations—Ratio of preformed sulphates to ethereal sulphates and neutral sulphur, Series VIII—Continued.*

[Averages are per day.]

## No. 12.

Period.	Total sulphur as S.	Total sulphur as SO <sub>3</sub> .	Neutral sulphur as SO <sub>3</sub> .	Total sulphates as SO <sub>3</sub> .	Ethereal sulphates as SO <sub>3</sub> .	Inorganic sulphates as SO <sub>3</sub> .	Ratio of ethereal to inorganic sulphates.	Results expressed in per cent of total sulphur in terms of SO <sub>3</sub> .			
								Neutral sulphur.	Total sulphates.	Ethereal sulphates.	Inorganic sulphates.
<i>Fore period.</i>											
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>		<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
Total.....	4.507	11.254	1.696	9.558	1.123	8.435	1:7.5	15.1	84.9	10.0	74.9
Average.....	.901	2.251	.339	1.912	.225	1.687					
Second subperiod:											
Total.....	4.605	11.499	1.525	9.974	1.061	8.913	1:8.4	13.3	86.7	9.2	77.5
Average.....	.921	2.300	.305	1.995	.212	1.783					
Entire fore period:											
Total.....	9.112	22.753	3.221	19.532	2.184	17.348	1:7.9	14.2	85.8	9.6	76.2
Average.....	.911	2.275	.322	1.953	.218	1.735					
<i>Preservative period.</i>											
First subperiod:											
Total.....	5.277	13.177	1.719	11.458	1.149	10.309	1:9.0	13.0	87.0	8.7	78.2
Average.....	1.055	2.635	.344	2.292	.230	2.062					
Second subperiod:											
Total.....	4.883	12.192	1.535	10.657	.987	9.670	1:9.8	12.6	87.4	8.1	79.3
Average.....	.977	2.438	.307	2.131	.197	1.934					
Third subperiod:											
Total.....	4.925	12.298	1.839	10.459	.953	9.506	1:10.0	15.0	85.0	7.7	77.3
Average.....	.985	2.460	.368	2.092	.191	1.901					
Fourth subperiod:											
Total.....	4.146	10.353	1.172	9.181	.923	8.258	1:8.9	11.3	88.7	8.9	79.8
Average.....	.829	2.071	.234	1.836	.185	1.652					
Entire preservative period:											
Total.....	19.231	48.020	6.265	41.755	4.012	37.743	1:9.4	13.0	87.0	8.4	78.6
Average.....	.962	2.401	.313	2.088	.201	1.887					
<i>After period.</i>											
First subperiod:											
Total.....	4.195	10.474	1.225	9.249	.771	8.478	1:11.0	11.7	88.3	7.4	80.9
Average.....	.839	2.095	.245	1.850	.154	1.696					
Second subperiod:											
Total.....	4.199	10.485	1.681	8.804	.730	8.074	1:11.0	16.0	84.0	7.0	77.0
Average.....	.840	2.097	.336	1.761	.146	1.615					
Entire after period:											
Total.....	8.394	20.959	2.906	18.053	1.501	16.552	1:11.0	13.9	86.1	7.2	79.0
Average.....	.839	2.096	.291	1.805	.150	1.655					



TABLE IX.—Urine determinations—Ratio of preformed sulphates to ethereal sulphates and neutral sulphur, Series VIII—Continued.

## SUMMARIES.

[Averages are per man per day.]

## Nos. 1 and 4.

Period.	Total sulphur as S.	Total sulphur as SO <sub>3</sub> .	Neutral sulphur as SO <sub>3</sub> .	Total sulphates as SO <sub>3</sub> .	Ethereal sulphates as SO <sub>3</sub> .	Inorganic sulphates as SO <sub>3</sub> .	Ratio of ethereal to inorganic sulphates.	Results expressed in per cent of total sulphur in terms of SO <sub>3</sub> .			
								Neutral sulphur.	Total sulphates.	Ethereal sulphates.	Inorganic sulphates.
<i>Fore period.</i>											
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>		<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
Total.....	8.822	22.028	3.016	19.012	1.583	17.429	1:11.0	13.7	86.3	7.2	79.1
Average.....	.882	2.203	.302	1.901	.158	1.743					
Second subperiod:											
Total.....	9.781	24.424	3.477	20.947	1.832	19.115	1:10.4	14.2	85.8	7.5	78.3
Average.....	.978	2.442	.348	2.095	.183	1.912					
Entire fore period:											
Total.....	18.603	46.452	6.493	39.959	3.415	36.544	1:10.7	14.0	86.0	7.4	78.7
Average.....	.930	2.323	.325	1.998	.171	1.827					
<i>Preservative period.</i>											
First subperiod:											
Total.....	9.393	23.456	2.266	21.190	1.620	19.570	1:12.1	9.7	90.3	6.9	83.4
Average.....	.939	2.346	.227	2.119	.162	1.957					
Second subperiod:											
Total.....	9.013	22.504	2.991	19.513	1.692	17.821	1:10.5	13.3	86.7	7.5	79.2
Average.....	.901	2.250	.299	1.951	.169	1.782					
Third subperiod:											
Total.....	8.971	22.401	2.514	19.887	1.669	18.218	1:10.9	11.2	88.8	7.5	81.3
Average.....	.897	2.240	.251	1.989	.167	1.822					
Fourth subperiod:											
Total.....	9.013	22.505	2.874	19.631	1.684	17.947	1:10.7	12.8	87.2	7.5	79.7
Average.....	.901	2.251	.287	1.963	.168	1.795					
Entire preservative period:											
Total.....	36.390	90.866	10.645	80.221	6.665	73.556	1:11.0	11.7	88.3	7.3	80.9
Average.....	.910	2.272	.266	2.006	.167	1.839					
<i>After period.</i>											
First subperiod:											
Total.....	9.006	22.488	2.409	20.079	1.582	18.497	1:11.7	10.7	89.3	7.0	82.3
Average.....	.901	2.249	.241	2.008	.158	1.850					
Second subperiod:											
Total.....	8.153	20.358	2.296	18.062	1.472	16.590	1:11.3	11.3	88.7	7.2	81.5
Average.....	.815	2.036	.230	1.806	.147	1.659					
Entire after period:											
Total.....	17.159	42.846	4.705	38.141	3.054	35.087	1:11.5	11.0	89.0	7.1	81.9
Average.....	.858	2.142	.235	1.907	.153	1.754					

TABLE IX.—*Urine determinations—Ratio of preformed sulphates to ethereal sulphates and neutral sulphur, Series VIII—Continued.*

SUMMARIES—Continued.

[Averages are per man per day.]

Nos. 1, 2, 4, 5, and 6.

Period.	Total sulphur as S.	Total sulphur as SO <sub>3</sub> .	Neutral sulphur as SO <sub>3</sub> .	Total sulphates as SO <sub>3</sub> .	Ethereal sulphates as SO <sub>3</sub> .	Inorganic sulphates as SO <sub>3</sub> .	Ratio of ethereal to inorganic sulphates.	Results expressed in per cent of total sulphur in terms of SO <sub>3</sub> .			
								Neutral sulphur.	Total sulphates.	Ethereal sulphates.	Inorganic sulphates.
<i>Fore period.</i>											
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>		<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
Total.....	21.655	54.074	7.714	46.360	3.751	42.609	1: 11.4	14.3	85.7	6.9	78.8
Average.....	.866	2.163	.309	1.854	.150	1.704					
Second subperiod:											
Total.....	23.337	58.273	8.640	49.633	4.166	45.467	1: 10.9	14.8	85.2	7.1	78.0
Average.....	.933	2.331	.346	1.985	.167	1.819					
Entire fore period:											
Total.....	44.992	112.347	16.354	95.993	7.917	88.076	1: 11.1	14.6	85.4	7.0	78.4
Average.....	.900	2.247	.327	1.920	.158	1.762					
<i>Preservative period.</i>											
First subperiod:											
Total.....	22.832	57.015	6.879	50.136	3.619	46.517	1: 12.9	12.1	87.9	6.3	81.6
Average.....	.913	2.281	.275	2.005	.145	1.861					
Second subperiod:											
Total.....	22.932	57.258	7.888	49.370	4.036	45.334	1: 11.2	13.8	86.2	7.0	79.2
Average.....	.917	2.290	.316	1.975	.161	1.813					
Third subperiod:											
Total.....	22.861	57.082	6.886	50.196	4.067	46.129	1: 11.3	12.1	87.9	7.1	80.8
Average.....	.914	2.283	.275	2.008	.163	1.845					
First, second, and third subperiods:											
Total.....	68.625	171.355	21.653	149.702	11.722	137.980	1: 11.8	12.6	87.4	6.8	80.5
Average.....	.915	2.285	.289	1.996	.156	1.840					
<i>After period.</i>											
First subperiod:											
Total.....	21.622	53.989	5.659	48.330	3.861	44.469	1: 11.5	10.5	89.5	7.2	82.4
Average.....	.865	2.160	.226	1.933	.154	1.779					
Second subperiod:											
Total.....	20.660	51.589	6.041	45.548	3.558	41.990	1: 11.8	11.7	88.3	6.9	81.4
Average.....	.826	2.064	.242	1.822	.142	1.680					
Entire after period:											
Total.....	42.282	105.578	11.700	93.878	7.419	86.459	1: 11.7	11.1	88.9	7.0	81.9
Average.....	.846	2.112	.238	1.878	.148	1.729					

TABLE IX.—*Urine determinations—Ratio of preformed sulphates to ethereal sulphates and neutral sulphur, Series VIII—Continued.*

SUMMARIES—Continued.

[Averages are per man per day.]

Nos. 7 to 12.

Period.	Total sulphur as S.	Total sulphur as SO <sub>3</sub> .	Neutral sulphur as SO <sub>3</sub> .	Total sulphates as SO <sub>3</sub> .	Ethereal sulphates as SO <sub>3</sub> .	Inorganic sulphates as SO <sub>3</sub> .	Ratio of ethereal to inorganic sulphates.	Results expressed in per cent of total sulphur in terms of SO <sub>3</sub> .			
								Neutral sulphur.	Total sulphates.	Ethereal sulphates.	Inorganic sulphates.
<i>Fore period.</i>											
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>		<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
Total.....	26.946	67.282	9.457	57.825	4.597	53.228	1:11.6	14.1	85.9	6.8	79.1
Average.....	.898	2.243	.315	1.928	.153	1.774					
Second subperiod:											
Total.....	26.477	66.115	8.763	57.352	4.708	52.644	1:11.2	13.3	86.7	7.1	79.6
Average.....	.883	2.204	.292	1.912	.157	1.755					
Entire fore period:											
Total.....	53.423	133.397	18.220	115.177	9.305	105.872	1:11.4	13.7	86.3	7.0	79.4
Average.....	.890	2.223	.304	1.920	.155	1.765					
<i>Preservative period.</i>											
First subperiod:											
Total.....	28.825	71.975	8.836	63.139	4.844	58.295	1:12.0	12.3	87.7	6.7	81.0
Average.....	.961	2.399	.295	2.105	.161	1.943					
Second subperiod:											
Total.....	26.478	66.116	7.931	58.185	4.335	53.850	1:12.4	12.0	88.0	6.6	81.4
Average.....	.883	2.204	.264	1.940	.145	1.795					
Third subperiod:											
Total.....	27.045	67.233	8.243	59.290	4.527	54.763	1:12.1	12.3	88.2	6.7	81.5
Average.....	.902	2.241	.275	1.976	.151	1.825					
First, second, and third subperiods:											
Total.....	82.348	205.324	25.010	180.614	13.706	166.908	1:12.2	12.2	88.0	6.7	81.3
Average.....	.915	2.281	.278	2.007	.152	1.855					
<i>After period.</i>											
First subperiod:											
Total.....	25.492	63.653	6.398	57.255	4.252	53.003	1:12.5	10.1	89.9	6.7	83.3
Average.....	.850	2.122	.213	1.909	.142	1.767					
Second subperiod:											
Total.....	26.064	65.081	7.796	57.285	4.066	53.219	1:13.1	12.0	88.0	6.2	81.8
Average.....	.869	2.169	.260	1.910	.136	1.774					
Entire after period:											
Total.....	51.556	128.734	14.194	114.540	8.318	106.222	1:12.8	11.0	89.0	6.5	82.5
Average.....	.859	2.146	.237	1.909	.139	1.770					

TABLE IX.—Urine determinations—Ratio of preformed sulphates to ethereal sulphates and neutral sulphur, Series VIII—Continued.

SUMMARIES—Continued.

[Averages are per man per day.]

Nos. 1 to 12, omitting No. 3.

Period.	Total sulphur as S.	Total sulphur as SO <sub>3</sub> .	Neutral sulphur as SO <sub>3</sub> .	Total sulphates as SO <sub>3</sub> .	Ethereal sulphates as SO <sub>3</sub> .	Inorganic sulphates as SO <sub>3</sub> .	Ratio ethereal to inorganic.	Results expressed in per cent of total sulphur in terms of SO <sub>3</sub> .			
								Neutral sulphur.	Total sulphates.	Ethereal sulphates.	Inorganic sulphates.
<i>Fore period.</i>											
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>		<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
Total.....	48.601	121.356	17.171	104.185	8.348	95.837	1:11.5	14.1	85.9	6.9	79.0
Average.....	.884	2.206	.312	1.894	.152	1.742					
Second subperiod:											
Total.....	49.814	124.388	17.403	106.985	8.874	98.111	1:11.1	14.0	86.0	7.1	78.9
Average.....	.906	2.262	.316	1.945	.161	1.784					
Entire fore period:											
Total.....	98.415	245.744	34.574	211.170	17.222	193.948	1:11.3	14.1	85.9	7.0	78.9
Average.....	.895	2.234	.314	1.920	.157	1.763					
<i>Preservative period.</i>											
First subperiod:											
Total.....	51.657	128.990	15.715	113.275	8.463	104.812	1:12.4	12.2	87.8	6.6	81.3
Average.....	.939	2.345	.286	2.060	.154	1.906					
Second subperiod:											
Total.....	49.410	123.374	15.819	107.555	8.371	99.184	1:11.8	12.8	87.2	6.8	80.4
Average.....	.898	2.243	.288	1.956	.152	1.803					
Third subperiod:											
Total.....	49.906	124.315	15.129	109.486	8.594	100.892	1:11.7	12.2	88.1	6.9	81.2
Average.....	1.803	2.160	2.275	1.991	.156	1.834					
First, second, and third subperiods:											
Total.....	150.973	376.679	46.663	330.316	25.428	304.888	1:12.0	12.4	87.7	6.8	80.9
Average.....	.915	2.283	.283	2.002	.154	1.848					
<i>After period.</i>											
First subperiod:											
Total.....	47.114	117.642	12.057	105.585	8.113	97.472	1:12.0	10.2	89.8	6.9	82.9
Average.....	.857	2.139	.219	1.920	.148	1.772					
Second subperiod:											
Total.....	46.724	116.670	13.837	102.833	7.624	95.209	1:12.5	11.9	88.1	6.5	81.6
Average.....	.850	2.121	.252	1.870	.139	1.731					
Entire after period:											
Total.....	93.838	234.312	25.894	208.418	15.737	192.681	1:12.2	11.1	88.9	6.7	82.2
Average.....	.853	2.130	.235	1.895	.143	1.752					



## MICROSCOPICAL EXAMINATION OF THE URINE.

The numbers used in representing the relative occurrence of microscopic bodies have the same values as in the previous parts of this bulletin, namely, none, 0; very few, 1; few, 2; fairly numerous, 3; numerous, 4; extremely numerous, 5.

## DISCUSSION OF OBSERVATIONS.

In Table X are given the results of the microscopical examination of the urine.

*Uric acid crystals and urates.*—In the case of No. 1 uric acid crystals are found only on two occasions, both in the preservative period. In the case of No. 2 there are a few in the fore period. In the case of No. 3 they exist only in the preservative period, a very few being found on two occasions. In the case of No. 4 they do not exist in the fore period and are present at all observations in the preservative period, reaching "fairly numerous" as a maximum. Nos. 5, 6, 9, 10, 11, and 12 show no uric-acid crystals whatever during any part of the observation. Nos. 7 and 8 have uric-acid crystals only during the preservative period, and then only very few were observed. The percentage figures for relative occurrence show 16.7 in the fore period, 37.1 in the preservative period, and 4.4 in the after period.

The existence of urates is not revealed by the microscope in any case with any of the men during the whole period of observation.

*Crystals of calcium oxalate.*—These crystals are present in all cases during the different periods of the observation, with the exception of No. 8. They are less numerous in the cases of Nos. 4, 9, and 12. The figures for relative occurrence again show an increase in the preservative period and a decrease in the after period.

*Crystalline phosphates.*—Crystalline phosphates are found in a few cases, notably Nos. 10 and 11. They are found in only one instance in the fore period, namely, the case of No. 10. The figures for relative occurrence show an increase in the preservative period but the data do not warrant very much importance being attached to them.

*Amorphous phosphates.*—Amorphous phosphates are found in a few instances, notably in the cases of Nos. 10 and 11. They occur more often in the preservative period, except in the cases of Nos. 2, 5, and 9 when they appear in the after period. The expression for relative occurrence shows a slight increase in the preservative period and this is further augmented in the after period.

*Epithelial cells.*—The epithelial cells are present quite uniformly throughout the whole period of observation. A few are uniformly present in the preservative period in the cases of Nos. 3, 4, 5, 6, and 7. They were fairly numerous throughout in the case of No. 2, and for the other members a very few were found at some observations and a few

at others. The percentage figures for relative occurrence indicate an increase in the preservative period and a decrease in the after period.

*Leucocytes.*—Leucocytes are quite uniformly present throughout the observation. They are somewhat more abundant in the preservative period in the cases of Nos. 7 and 9 than in the fore period. The relative occurrence is slightly greater in the preservative period and decreases in the after period.

*Red blood cells.*—The microscope does not reveal the presence of any red blood cells in the urine during any period of the observation.

*Hyaline casts.*—Hyaline casts are quite uniformly present throughout the observation in all the cases, but “a few” is the maximum amount recorded. The figures for relative occurrence show a decrease throughout the observation.

*Finely granular casts.*—A very few finely granular casts are found in all cases with the exception of Nos. 1, 8, and 12. They appear to be more numerous in the preservative period than in either of the others, as is shown in the figures for relative occurrence.

*Coarsely granular casts.*—A few coarsely granular casts appear at irregular intervals during the observation in all cases except Nos. 9 and 12. They are apparently again somewhat more numerous in the preservative period than in either of the others.

*Epithelial casts.*—In no case are any epithelial casts discovered in any of the samples during the whole period of the observation.

*Mucous cylindroids.*—The mucous cylindroids are uniformly present and in the cases of Nos. 1 and 6 are recorded as numerous on several occasions. They are fairly numerous in the cases of Nos. 4, 7, and 8. There is evidence of an increase in these bodies during the preservative period as indicated by the figures for relative occurrence which are 141.7, 205.7, and 152.2 for the three periods, respectively.

*Mucous strands.*—Mucous strands are present throughout the whole period of observation, and they are recorded as numerous in the cases of Nos. 1, 4, 6, 7, and 8. In this case there is again shown a marked increase in the preservative period followed by a decrease in the after period, the figures for the relative occurrence being 225, 240, and 160.9, respectively.

#### CONCLUSION.

The general expression of the relative occurrence of all the microscopic bodies in the urine is 64.4, 75.2, and 59.1 for the three periods, respectively. These figures, therefore, indicate a slight tendency to increase the presence of these bodies during the preservative period. A general survey of the individual data does not show a marked effect in the case of all these bodies, the figures for epithelial cells, mucous strands, and mucous cylindroids being most markedly increased. It may be fair to conclude that there is a slight tendency to promote renal activity during the preservative period.

TABLE X.—*Microscopical examination of the urine, Series VIII.*

(None, 0; very few, 1; few, 2; fairly numerous, 3; numerous, 4; extremely numerous, 5.)

No.	Fore period.		Preservative period.		After period.		No.	Fore period.		Preservative period.		After period.	
	Apr. 18-21.	Apr. 25-27.	May 3-4.	May 6-11.	May 13-17.	May 19-21.		Apr. 18-21.	Apr. 25-27.	May 3-4.	May 6-11.	May 13-17.	May 19-21.
URIC-ACID CRYSTALS.							AMORPHOUS PHOSPHATES.						
1.....	0	0	1	2	0	0	1.....	0	0	0	0	0	0
2.....	2	0	0	0	0	0	2.....	0	0	0	0	2	1
3.....	0	1	0	1	0	0	3.....	0	0	0	1	0	0
4.....	0	2	3	1	1	0	4.....	0	0	3	0	0	0
5.....	0	0	0	0	0	0	5.....	0	0	0	0	0	5
6.....	0	0	0	0	0	0	6.....	0	0	0	0	0	0
7.....	0	0	0	1	0	0	7.....	0	0	0	0	0	0
8.....	0	0	1	0	0	0	8.....	0	0	0	0	0	0
9.....	0	0	0	0	0	0	9.....	0	0	0	0	1	3
10.....	0	0	0	0	0	0	10.....	4	0	2	2	5	2
11.....	0	0	0	0	0	0	11.....	0	0	3	5	4	0
12.....	0	0	0	0	0	0	12.....	0	0	0	0	0	0
Total.....	2	3	5	5	1	0	Total.....	4	0	8	8	12	11
Relative occurrence.....	16.67	37.14			4.35		Relative occurrence.....	33.33	45.71			100.00	
CRYSTALS OF CALCIUM OXALATE.							EPITHELIAL CELLS.						
1.....	2	3	3	1	2	2	1.....	1	2	1	2	1	a 1
2.....	1	2	1	2	1	0	2.....	2	3	3	a 3	a 2	a 2
3.....	0	2	2	2	0	0	3.....	2	2	2	2	a 2	a 2
4.....	1	1	0	1	1	1	4.....	2	2	2	2	2	2
5.....	2	3	2	2	2	1	5.....	2	2	2	2	2	a 1
6.....	2	2	1	1	1	0	6.....	2	2	a 2	2	2	0
7.....	0	2	1	1	1	0	7.....	1	2	2	2	1	1
8.....	0	0	0	0	0	0	8.....	1	2	2	1	1	1
9.....	2	1	1	1	1	2	9.....	2	1	2	2	2	2
10.....	3	3	2	2	3	1	10.....	2	a 2	2	1	2	a 2
11.....	2	1	1	1	2	2	11.....	2	2	2	1	1	2
12.....	1	0	1	0	1	0	12.....	2	2	1	2	1	1
Total.....	16	20	15	13	15	9	Total.....	21	24	23	20	19	17
Relative occurrence.....	133.33	137.14			104.35		Relative occurrence.....	175.00	191.43			156.52	
CRYSTALLINE PHOSPHATES.							LEUCOCYTES.						
1.....	0	0	0	0	0	0	1.....	0	1	0	1	1	1
2.....	0	2	0	0	0	1	2.....	1	1	1	1	0	1
3.....	0	0	0	1	0	0	3.....	1	1	1	1	0	0
4.....	0	0	0	0	0	0	4.....	1	1	1	1	0	2
5.....	0	0	0	0	0	0	5.....	1	0	1	1	0	1
6.....	0	0	0	0	0	0	6.....	1	1	1	1	1	1
7.....	0	0	0	0	0	0	7.....	1	1	2	2	1	1
8.....	0	0	0	0	0	0	8.....	1	1	1	0	0	1
9.....	0	0	0	0	2	1	9.....	1	1	2	1	1	0
10.....	2	0	2	1	1	1	10.....	1	1	1	1	0	0
11.....	0	0	2	2	2	0	11.....	0	1	1	0	1	1
12.....	0	0	0	0	0	0	12.....	1	1	1	1	1	1
Total.....	2	2	4	4	5	3	Total.....	10	11	13	10	6	10
Relative occurrence.....	16.67	28.57			34.78		Relative occurrence.....	83.33	97.14			69.57	

a Some in sheets.



TABLE X.—*Microscopical examination of the urine, Series VIII—Continued.*

(None, 0; very few, 1; few, 2; fairly numerous, 3; numerous, 4; extremely numerous, 5.)

No.	Fore period.	Preservative period.			After period.	
	Apr. 18-21.	Apr. 25-27.	May 3-4.	May 6-11.	May 13-17.	May 19-21.
HYALINE CASTS.						
1.....	2	1	1	1	1	1
2.....	1	1	1	1	1	1
3.....	1	1	1	1	0	1
4.....	1	1	1	2	1	2
5.....	1	1	0	0	0	0
6.....	1	2	1	1	2	1
7.....	1	1	0	1	0	2
8.....	0	1	1	1	0	0
9.....	2	1	0	1	1	0
10.....	1	2	1	1	0	0
11.....	1	2	0	0	0	1
12.....	1	2	2	1	1	1
Total.....	13	16	9	10	7	9
Relative occurrence.....	108.33	100.00			69.57	
FINELY GRANULAR CASTS.						
1.....	0	0	0	0	0	0
2.....	0	0	0	0	1	0
3.....	1	1	1	0	0	1
4.....	0	1	0	1	0	0
5.....	0	1	0	0	0	0
6.....	0	1	0	1	0	1
7.....	0	1	0	0	0	1
8.....	0	0	0	0	0	0
9.....	1	0	0	0	0	0
10.....	0	0	1	0	0	0
11.....	0	0	0	0	0	1
12.....	0	0	0	0	0	0
Total.....	2	5	2	2	1	3
Relative occurrence.....	16.67	25.71			17.39	
COARSELY GRANULAR CASTS.						
1.....	0	0	0	0	0	1
2.....	1	0	0	1	0	0
3.....	1	0	0	0	0	1
4.....	0	1	0	0	0	0
5.....	0	1	0	0	0	0
6.....	0	1	0	0	0	0
7.....	0	0	0	1	0	0
8.....	0	1	0	0	0	0
9.....	0	0	0	0	0	0
10.....	0	0	0	0	1	0
11.....	0	0	0	1	0	0
12.....	0	0	0	0	0	0
Total.....	2	4	0	3	1	2
Relative occurrence.....	16.67	20.00			13.04	

No.	Fore period.	Preservative period.			After period.	
	Apr. 18-21.	Apr. 25-27.	May 3-4.	May 6-11.	May 13-17.	May 19-21.
MUCOUS CYLINDROIDS.						
1.....	2	2	3	4	2	4
2.....	1	1	2	2	1	2
3.....	1	1	2	2	1	2
4.....	1	3	2	2	1	2
5.....	1	1	1	2	2	1
6.....	4	4	3	4	3	3
7.....	2	3	3	3	2	3
8.....	1	1	3	2	1	1
9.....	1	2	3	3	1	1
10.....	1	2	2	1	1	1
11.....	1	2	1	1	1	2
12.....	1	2	1	2	1	1
Total.....	17	24	24	24	16	19
Relative occurrence.....	141.67	205.71			152.17	
MUCOUS STRANDS.						
1.....	3	4	4	4	2	4
2.....	1	1	2	2	1	2
3.....	2	1	2	2	1	1
4.....	2	4	2	2	2	3
5.....	1	2	1	2	2	1
6.....	4	4	3	4	3	2
7.....	4	4	3	2	2	2
8.....	2	2	4	2	1	1
9.....	2	2	2	2	1	1
10.....	2	2	2	2	1	1
11.....	2	2	2	1	1	2
12.....	2	2	2	2	1	1
Total.....	27	30	29	25	18	19
Relative occurrence.....	225.00	240.00			160.87	
SUMMARY.						
Total.....	116	395			204	
Relative occurrence.....	64.44	75.24			59.13	



**MICROSCOPICAL EXAMINATION OF THE BLOOD.**

Table XI contains the data showing the number of red and white corpuscles and the percentage of hemoglobin in the blood as observed for the three periods.

**INDIVIDUAL DATA.**

In the case of No. 1 it is seen that there is a progressive increase in the number of red corpuscles in the preservative and after periods. There is a diminution in the white corpuscles in the preservative period and the same number is found in the after period as in the preservative period. The percentage of hemoglobin is slightly diminished in the preservative period and increased in the after period.

There are no data for the fore period in the case of No. 2, but an increase both in the number of red and white corpuscles is shown in the after period. The percentage of hemoglobin remains the same in the two periods.

The data for No. 3 show a marked diminution in the number of red corpuscles in the preservative period and an increase in the number of white corpuscles. There is a very slight increase in the number of red corpuscles in the after period over the preservative period and a marked decrease in the number of white corpuscles. There is no difference in the percentage of hemoglobin in the blood in the fore and preservative periods, but an increase is recorded in the after period.

No. 4 shows a decrease in the number of red and white corpuscles in the preservative period and the decrease in red corpuscles is continued in the after period, while the white corpuscles return in the after period to the same magnitude as in the fore period. There is a very slight decrease in the percentage of hemoglobin in the blood in the preservative and after periods as compared with the fore period.

The case of No. 5 shows a notable decrease of nearly 2,000,000 in the number of red corpuscles in the preservative period. The number increases in the after period but does not reach that of the fore period. The decrease in the number of white corpuscles in the preservative period is also very marked and followed by a slight decrease in the after period. There is a slight increase in the hemoglobin in the preservative period with a return in the after period to the figure of the fore period.

The data for No. 6 also show a decrease in the number of red corpuscles in the preservative period and an increase in the after period. The white corpuscles are increased very considerably in the preservative period and show a decrease in the after period. The hemoglobin increases slightly both in the preservative and the after periods.

In the case of No. 7 there is a marked increase of over a million in the number of red corpuscles in the blood in the preservative period and this number is somewhat increased in the after period. There is

also a marked increase in the number of white corpuscles during the preservative period and a very slight increase in the percentage of hemoglobin. In the after period the hemoglobin remains unchanged.

No. 8 shows a marked increase in the number of red corpuscles in the preservative period and a very decided decrease in the after period. There is also a slight increase in the number of white corpuscles in the preservative period and a marked decrease in the after period. The percentage of hemoglobin is less in the preservative period than in either the fore or after periods.

In the case of No. 9 there is a decrease in the number of red corpuscles in the preservative period and an increase in the after period, and the same is true of the number of white corpuscles. There is a very marked decrease in the quantity of hemoglobin in the preservative period and a return to normal in the after period.

No. 10 shows an increase in the number of red corpuscles both in the preservative and after periods. There is a very marked decrease in the number of white corpuscles in the preservative period which is not wholly restored in the after period. There is a notable deficiency of hemoglobin during the preservative period.

No. 11 shows a decrease in the number of red corpuscles in the preservative period and an increase in the after period. There is an increase in the number of white corpuscles in the preservative period and a decrease in the after period. The hemoglobin in the preservative and after periods is very slightly increased over that of the fore period.

In the case of No. 12 there is again an increase in the number of red corpuscles in the blood during the preservative period and a decrease in the after period. The number of white corpuscles is also slightly greater in the preservative period and markedly less in the after period. The hemoglobin is slightly greater both in the preservative and after periods than in the fore period.

#### SUMMARIES.

A summary of the data for Nos. 1 to 6, inclusive, who received benzoic acid, shows that the number of red corpuscles in the blood is very notably diminished in the preservative period, while in the after period it rises again almost to the number of the fore period. The number of white corpuscles is very slightly diminished in the preservative period and still further decreased in the after period. There is practically no effect produced upon the hemoglobin either in the preservative or after periods. The conclusion to be drawn from this summary is that there is a tendency on the part of the benzoic acid to diminish the number of red corpuscles in the blood.

From the summary for Nos. 7 to 12 it is seen that there is a notable increase in the number of red corpuscles in the blood and the

increase continues, though not to the same extent, in the after period. There is scarcely any change in the number of white corpuscles in the blood in the preservative period but a diminution of the number of white corpuscles occurs in the after period. There is scarcely any change produced in the percentage of hemoglobin in the blood.

The conclusion drawn from this series of data is that there is a tendency on the part of the preservative, when administered in the form of benzoate of soda, to increase the number of red corpuscles in the blood, accompanied by a very slight increase in white corpuscles.

In this connection attention should be called to the fact that no particular significance was attached to the count of the blood corpuscles in this study, and for this reason it was made only once during each of the periods. The data, however, show that not enough attention was paid to this particular phase of investigation. In one instance in the administration of benzoic acid the number of red corpuscles was increased, while in two cases in the administration of the benzoate of soda the number of red corpuscles was decreased. Therefore in the interpretation of the data these facts must be kept in mind. While the general effect of the benzoic acid appears to be to diminish the red corpuscles and that of the benzoate of soda to increase their number, there are exceptions in the individual data. Before drawing a final conclusion respecting this matter it would be desirable to repeat the test, making daily counts of the blood corpuscles in order that the accidental variation which may take place in a blood count might be eliminated. It may be further suggested that the tendency to increase the red corpuscles shown by the benzoate of soda may have arisen from the greater alkalinity of the blood induced by the soda rather than from any specific action of the compound as a whole.



TABLE XI.—*Averages, by periods, of corpuscles and hemoglobin in the blood, Series VIII.*

Period.	Date.	No. 1.			No. 2.		
		Red corpuscles per cubic millimeter.	White corpuscles per cubic millimeter.	Hemoglobin.	Red corpuscles per cubic millimeter.	White corpuscles per cubic millimeter.	Hemoglobin.
	1904.			<i>Per ct.</i>			<i>Per ct.</i>
Fore period.....	Apr. 19 to 20....	3,770,000	5,595	95			
Preservative period.....	May 6 to 11.....	4,415,000	5,318	94	5,100,000	7,922	98
After period.....	May 18 to 20....	4,955,000	5,318	97	5,670,000	7,978	98
Period.	Date.	No. 3.			No. 4.		
	1904.						
Fore period.....	Apr. 19 to 20....	5,130,000	5,595	92	5,625,000	7,257	97
Preservative period.....	May 6 to 11.....	4,765,000	5,817	92	5,470,000	6,336	96
After period.....	May 18 to 20....	4,780,000	4,377	94	4,960,000	7,257	96
Period.	Date.	No. 5.			No. 6.		
	1904.						
Fore period.....	Apr. 19 to 20....	6,150,000	9,861	96	5,570,000	9,529	96
Preservative period.....	May 6 to 11.....	4,395,000	6,482	97	5,125,000	11,357	97
After period.....	May 18 to 20....	5,390,000	6,371	96	5,620,000	8,199	98
Period.	Date.	No. 7.			No. 8.		
	1904.						
Fore period.....	Apr. 19 to 20....	4,275,000	7,091	96	4,875,000	6,260	97
Preservative period.....	May 6 to 11.....	5,250,000	9,473	97	5,575,000	6,703	96
After period.....	May 18 to 20....	5,380,000	7,147	97	4,535,000	5,263	97
Period.	Date.	No. 9.			No. 10.		
	1904.						
Fore period.....	Apr. 19 to 20....	5,060,000	6,537	98	4,670,000	9,473	99
Preservative period.....	May 6 to 11.....	4,640,000	6,039	93	5,425,000	6,039	95
After period.....	May 18 to 20....	5,525,000	7,424	98	5,775,000	8,310	97
Period.	Date.	No. 11.			No. 12.		
	1904.						
Fore period.....	Apr. 19 to 20....	5,495,000	6,205	95	5,285,000	8,365	94
Preservative period.....	May 6 to 11.....	5,285,000	7,590	96	5,750,000	8,919	95
After period.....	May 18 to 20....	5,775,000	6,043	96	4,695,000	6,039	96

## SUMMARIES.

Period.	Nos. 1 to 6.			Nos. 7 to 12.			Nos. 1 to 12.		
	Red corpuscles per cubic millimeter.	White corpuscles per cubic millimeter.	Hemoglobin.	Red corpuscles per cubic millimeter.	White corpuscles per cubic millimeter.	Hemoglobin.	Red corpuscles per cubic millimeter.	White corpuscles per cubic millimeter.	Hemoglobin.
Fore period:			<i>P. ct.</i>			<i>P. ct.</i>			<i>P. ct.</i>
Total.....	26,245,000	37,837	476	29,660,000	43,931	579	55,905,000	81,768	1,055
Average.....	5,249,000	7,567	95	4,943,333	7,322	97	5,082,273	7,433	96
Preservative period:									
Total.....	29,270,000	43,212	574	31,925,000	44,763	572	61,195,000	87,975	1,146
Average.....	4,878,333	7,202	96	5,320,833	7,461	95	5,099,583	7,331	96
After period:									
Total.....	31,375,000	39,500	579	31,685,000	40,226	581	63,000,000	79,726	1,160
Average.....	5,229,167	6,583	97	5,280,833	6,704	97	5,255,000	6,644	97

*a* Five men only.*b* Eleven men only.*c* Twelve men.



**METABOLIC PROCESSES.****NITROGEN BALANCE.****INDIVIDUAL DATA.***No. 1.*

In the case of No. 1 the average daily content of nitrogen in the feces in the fore period is 0.68 gram, in the preservative period 0.73 gram, and in the after period 0.85 gram. There is a slightly larger quantity of nitrogen, however, in the food in the preservative period and the weight of dry feces decreases. The increase in the quantity of nitrogen in the feces in the after period over the fore period is probably due to decreased assimilation, as the weight of the dry feces increases, indicating a tendency in this case to increase the excretion of nonmetabolized nitrogen. The quantity of nitrogen appearing in the urine is greater in the preservative period and considerably diminished in the after period. The percentage of nitrogen excreted in the feces in both the preservative and after periods is greater than in the fore period, while in the urine a slightly larger percentage is excreted during the preservative period and a decidedly smaller percentage in the after period than in the fore period. The balance is positive in all cases and amounts to 0.53 gram in the fore period, 0.39 gram in the preservative period, and 1.41 grams in the after period.

*No. 2.*

In the case of No. 2 the quantity of nitrogen excreted in the feces is increased in the preservative and in the after periods over the fore period, the larger increase occurring in the preservative period. The amount in the urine is practically the same in the fore and the after periods, but is increased about 1 gram in the preservative period. The total excretion of nitrogen in both feces and urine is increased 1.32 grams during the preservative period, while in the after period the increase as compared with the fore period is only 0.32 gram, showing a tendency to return to the original conditions. The nitrogen excreted in the feces is 1.76 per cent greater in the preservative period and 1.42 per cent greater in the after period than in the fore period. The percentage excreted in the urine increases 4.44 per cent in the preservative period and 4.78 per cent in the after period as compared with the fore period, making a total percentage increase in elimination of 6.2 in both feces and urine in the preservative and after periods as compared with the fore period. The balance is positive in all cases and amounts to 1.65 grams in the fore period, decreasing to 0.44 gram in the preservative period and to 0.42 gram in the after period. These data would indicate a

decided increase in the excretion both of the metabolized and non-metabolized nitrogen.

*No. 3.*

In the case of No. 3 the quantity of nitrogen excreted in the feces is somewhat increased in the preservative period and notably diminished in the after period as compared with the fore period. The quantity of nitrogen in the urine is practically the same in the fore and in the preservative periods, and less in the after period. The total nitrogen in the feces and urine is almost exactly the same in the fore and the preservative periods and about 1 gram per day less in the after period. The percentage data show that in the feces the nitrogen excretion is greater in the preservative period and decidedly less in the after period. In the urine it is again greater in the preservative period and notably less in the after period. In both feces and urine the excretion is 3.52 per cent greater in the preservative period, and 9.39 per cent less in the after period than in the fore period. The balance is positive in all cases and amounts to 1.35 grams, 0.73 gram, and 3.03 grams daily for the three periods, respectively. These data are excluded from the summaries, as the subject became ill in the third preservative subperiod and the administration of the benzoic acid was discontinued.

*No. 4.*

In the case of No. 4 there is a slight decrease in the quantity of nitrogen in the feces in the preservative period and also in the after period. There is a slight decrease of nitrogen in the urine in the preservative period, but in the after period it is almost the same as in the fore period. In the feces and urine together there is a decrease of nitrogen of 0.41 gram in the preservative period and a very slight decrease in the after period, as compared with the fore period. Expressed in percentages it is seen that the percentage excretion of nitrogen in the feces is almost the same in the three periods. The percentage excretion of nitrogen in the urine is greatest in the fore and after periods, with the same relation for the total percentage, the figures being 99.31, 95.88, and 99.63 for the three periods, respectively. The high percentage of excretion in the fore and after periods is deserving of note in this connection. The daily balance is positive throughout and amounts to 0.10 gram, 0.58 gram, and 0.05 gram, respectively, for the three periods. The nitrogen equilibrium is well maintained in this case, there being a tendency to increase the assimilation of nitrogen slightly.

*No. 5.*

The case of No. 5 shows a marked increase in the excretion of nitrogen in the feces both in the preservative and after periods over the

fore period. There is also a marked increase in the excretion of nitrogen in the preservative period in the urine, and a slight increase over the fore period in the after period. The total elimination shows an increase of 1.43 grams in the amount of nitrogen excreted in the feces and urine in the preservative period, while the figure for the after period is almost the same as in the fore period. Expressed as percentage excretion it is seen that a much larger percentage is excreted in the feces in the preservative period, amounting to 2.12 per cent. This is true also of the urine, with the result that the increase in total elimination is 9.86 per cent. The balance is positive in all cases and amounts to 1.58 grams, 0.53 gram, and 1.56 grams, respectively, for the three periods, showing a marked decrease in the preservative period, while the nitrogen ingested was slightly increased throughout the observation.

*No. 6.*

No. 6 shows a decrease in the amount of nitrogen excreted in the feces in the preservative period and a still further decrease in the after period. There is also a decrease of a similar character in the nitrogen excreted in the urine. It is to be observed in this connection that the nitrogen in the food also decreases very slightly throughout. Expressed as percentage amounts it is seen that there is a much larger percentage excreted both in the feces and urine in the fore period than in either the preservative or after period. The balance is positive in all cases and its magnitude is 0.18 gram, 1.04 grams, and 1.43 grams, respectively, for the three periods. These data indicate an opposite tendency to those for the preceding cases, only No. 4 having shown an increased balance in the preservative period.

*No. 7.*

The data for No. 7 show a decrease in the quantity of nitrogen both in the feces and in the urine during the preservative period. In the after period there is an increase in the quantity excreted in the feces but a further decrease in the quantity excreted in the urine. In the urine and feces together the largest excretion is during the fore period, followed by a continuous decrease in the preservative and after periods. It is to be noted that there is also a decrease in the amount of nitrogen ingested throughout the experiment. Expressed as percentages, the largest amount excreted in the feces is in the after period and the smallest in the preservative period. In the urine the largest percentage is excreted in the fore period and the smallest in the after period. The total elimination is largest in the fore period and decreases throughout. The balance is positive in all cases, the magnitudes being 0.79 gram, 1.55 grams, and 1.58 grams, respectively, for the three periods. In this case there is again an



increase in the balance in the preservative period, notwithstanding the decrease in the nitrogen ingested.

*No. 8.*

The data for No. 8 indicate an increase in the amount of nitrogen excreted in the feces both in the preservative and after periods. There is a similar increase in the metabolized nitrogen excreted in the urine, giving an increase in total elimination of about 1 gram daily in the preservative period and of 1.32 grams in the after period as compared with the fore period. The nitrogen ingested increased 0.47 gram in the preservative period and only 0.3 gram in the after period. The largest percentage excretion in the feces occurs in the after period and the smallest in the fore period, and the same relative excretion is given for the urine. The balance is positive in the fore and preservative periods, and negative in the after period, the figures being 0.54 gram, 0.05 gram, and -0.48 gram for the average daily balance in the three periods. This marked continuous decrease in the balance is the more important when the variations in the nitrogen ingested are considered

*No. 9.*

The balance sheet for No. 9 shows a decrease in the quantity of nitrogen excreted in the feces in the preservative period and a restoration of the quantity to even more than the original amount in the after period. There is an increase in the quantity of nitrogen excreted in the urine in the preservative period and a slightly greater increase in the after period. In both feces and urine the average daily amounts excreted in the fore and preservative periods are the same, while the average amount excreted daily in the after period is greater. Expressed in percentages the smallest excretion of nitrogen in the feces is in the preservative period and the largest in the after period. In the urine the percentages excreted in the fore and in the preservative periods are almost identical, while that for the after period is increased. The balance in all cases is positive and its magnitude is 1.55 grams, 2.03 grams, and 1.09 grams, respectively, for the three periods. These data are in marked contrast to those for No. 8, but it will be noted that the increased balance is accompanied by an increased ingestion of 0.48 gram daily in the preservative period, exactly the increase in the balance.

*No. 10.*

The table for No. 10 shows an increase in the quantity of nitrogen excreted in the feces both in the preservative and after periods. The quantity of nitrogen excreted in the urine is almost the same for the fore and preservative periods, and is but slightly greater in the after



period. The total elimination of nitrogen in the feces and urine is slightly greater both in the preservative and after periods than in the fore period, notwithstanding the fact that the quantity ingested in the preservative period decreases 1.13 grams daily. This is brought out by the percentage data, which show an increased excretion in the preservative period of 1.18 and 8.8 per cent in the feces and urine, respectively. In the after period the nitrogen in the feces again increased while that in the urine decreased but still exceeded the figure for the fore period. In both feces and urine the largest percentage excreted is in the preservative period and the smallest in the fore period. The balance is positive in all cases and is abnormally high, being 3.59 grams in the fore period, 1.87 grams in the preservative period, and 2.46 grams in the after period. The decrease in the balance exceeds the decrease in nitrogen ingested by 0.59 gram daily.

*No. 11.*

The data for No. 11 show an increase in the excretion of nitrogen in the feces and in the urine for both the preservative and after periods as compared with the fore period. There is, however, a continuous increase in the nitrogen ingested. The largest percentage of nitrogen excreted in the feces is in the preservative period, and the smallest in the fore period, and the same is true of the percentage of nitrogen excreted in the urine. The balances are positive in all cases and unusually high, amounting to 2.59 grams in the fore period, 0.91 gram in the preservative period, and 2.03 grams in the after period. In this case the balance decreases despite the increase in the nitrogen ingested.

*No. 12.*

In the case of No. 12 the nitrogen excreted in the feces in the three periods is almost identical. There is a slight increase in the quantity excreted in the urine in the preservative period and a marked decrease in the after period. In feces and urine together the largest quantity of nitrogen is excreted during the preservative period and the smallest in the after period. The largest percentage of nitrogen excreted in the feces is in the after period and the smallest in the preservative period. The largest percentage of nitrogen occurring in the urine is in the preservative period and the smallest in the fore period. Considering both feces and urine, the largest percentage of nitrogen is excreted in the preservative period and the smallest in the fore period. The balances are positive and abnormally high in all cases, being 3.60 grams, 2.06 grams, and 2.36 grams daily for the three periods, respectively. There is also a slight decrease in the nitrogen ingested in the preservative period and a very marked decrease in the after period.

## SUMMARIES.

The summaries give the data for Nos. 1 and 4 throughout the whole period of observation and for Nos. 1, 2, 4, 5, and 6, excluding the fourth preservative subperiod. The men thus compared received the preservative as benzoic acid. The summary for Nos. 7 to 12 allows a comparison of the average effect of the preservative administered as benzoate of soda, while the mass effect on Nos. 1 to 12 (omitting No. 3) is shown in the final summary covering the entire observation with the exception of the fourth preservative subperiod.

The figures for Nos. 1 and 4 show a very slight increase in the quantity of metabolized and nonmetabolized nitrogen excreted in the preservative period, which is less than the increase in nitrogen ingested. The percentage data show a slight decrease in total elimination amounting to 1.15 per cent in the preservative period. In the after period there is a slight increase in the percentage of nitrogen excreted in the feces and a decrease in the metabolized nitrogen excreted and in the total excretion, the nitrogen in the food remaining practically constant as compared with the fore period. The balances are all positive and show a slight increase throughout.

The data for Nos. 1, 2, 4, 5, and 6 show a slight increase in the quantity of nitrogen excreted in the feces during the preservative period, while the amount excreted in the after period is almost exactly that of the fore period. There is a notable increase of the nitrogen excreted in the urine in the preservative period, while in the after period the quantity is slightly less than that of the fore period. In the feces and urine together 13.90 grams of nitrogen are excreted in the fore period, 14.44 grams in the preservative period, and 13.55 grams in the after period, an increase of 0.54 gram daily in the preservative period. In this connection, however, it is to be noted that the daily average amount of nitrogen ingested increased 0.38 gram daily, again decreasing in the after period. The percentage data expressing this relation show that 7.69 per cent of the nitrogen occurs in the feces in the fore period, 8.01 per cent in the preservative period, and 7.68 per cent in the after period. In the urine the relative percentages excreted are almost the same for the three periods, being slightly greater in the preservative period and slightly less in the after period than in the fore period. The balances are positive in all cases and have a magnitude of 0.81 gram, 0.65 gram, and 0.97 gram, respectively, for the three periods, thus showing a small decrease in the balance in the preservative period notwithstanding the increase in the amount ingested. This summary shows a slight increase in the quantity of nitrogen excreted both in the feces and the urine in the preservative period (1.18 per cent), but this increase in itself is hardly of sufficient magnitude to demonstrate that the benzoic acid produced an injurious effect upon nitrogen metabolism.

The summary for Nos. 7 to 12, inclusive, who received benzoate of soda, shows that the amount of nitrogen excreted in the feces is almost the same for the fore and preservative periods, while it is slightly increased in the after period. There is a tendency to increase the excretion of nitrogen in the urine during the preservative period, amounting to 0.70 gram daily, while in the after period the amount excreted is almost the same as in the fore period. In the total excretion there is an increase in the quantity of nitrogen excreted during the preservative period, amounting to 0.73 gram daily, while there is a tendency shown in the after period to return to the original conditions. In this case the average ingestion increased 0.31 gram daily in the preservative period and decreased in the after period. The largest percentage of nitrogen excreted in the feces is in the after period and the smallest in the fore period. In the urine the largest percentage of nitrogen excreted is in the preservative period and the smallest in the fore period, and the percentages of total elimination also show an increase in the preservative period and a slight further increase in the after period. The balances are positive in all cases and their magnitudes are 2.11 grams, 1.69 grams, and 1.51 grams, respectively. The decrease of 0.42 gram daily in the balance is the more marked since the nitrogen ingested increased 0.31 gram daily. These data indicate a slight tendency on the part of the benzoate of soda to increase the excretion of the metabolized and nonmetabolized nitrogen.

The mass action of both the benzoic acid and the benzoate of soda is shown in the summary for the eleven men. This summary indicates a very slight increase in the quantity of nitrogen in the feces in the preservative and after periods. There is an average increase of nitrogen in the urine in the preservative period of 0.59 gram daily, while in the after period the amount excreted is less than in the fore period. In the feces and urine 13.82 grams of nitrogen are excreted daily in the fore period, 14.47 grams in the preservative period, and 13.75 grams in the after period, an increase of 0.65 gram daily in the preservative period. The increase in nitrogen ingested was 0.35 gram daily. The largest percentage excretion of nitrogen in the feces is in the after period and the smallest in the fore period. The largest percentage of nitrogen excreted in the urine is in the preservative period. The balances are all positive and of very nearly the same magnitude, being 1.52 grams, 1.22 grams, and 1.26 grams daily, for the three periods, respectively, a decrease of practically 0.30 gram in connection with which the increased ingestion of 0.35 gram daily should be noted. While the average data do not show any great disturbance of the nitrogen metabolism there is a uniform tendency to decrease the nitrogen balance, while the amounts ingested were



slightly increased. The percentages of metabolized and nonmetabolized nitrogen excreted in the preservative period are both increased, especially the metabolized nitrogen, which increases about 2 per cent in the preservative period for Nos. 1 to 12, excluding No. 3.

A review of the individual sheets shows that in seven out of the twelve cases an increase of total nitrogen excreted, in both feces and urine, occurs in the preservative period while in five of these cases there is an increase in the nitrogen ingested in the food. The increased elimination, however, exceeds the increase in ingestion. All of the data, therefore, show a slight tendency on the part of the preservatives employed to retard the assimilation of the nitrogenous constituents of the food and to increase slightly the katabolic activities.

TABLE XII.—*Nitrogen balances for Series VIII.*

[Averages are per day.]

## No. 1.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Balance (1-4).	9 Ben- zoic acid admin- istered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	64.70	2.66	58.26	60.92	4.11	90.05	94.16	+ 3.78	0.0
Average.....	12.94	.53	11.65	12.18				+ .76	.0
Second subperiod:									
Total.....	71.60	4.13	65.93	70.06	5.77	92.08	97.85	+ 1.54	.0
Average.....	14.32	.83	13.19	14.01				+ .31	.0
Entire fore period:									
Total.....	136.30	6.79	124.19	130.98	4.98	91.12	96.10	+ 5.32	.0
Average.....	13.63	.68	12.42	13.10				+ .53	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	71.33	4.30	66.44	70.74	6.03	93.14	99.17	+ .59	5.00
Average.....	14.27	.86	13.29	14.15				+ .12	1.00
Second subperiod:									
Total.....	68.35	2.81	61.18	63.99	4.11	89.51	93.62	+ 4.36	7.50
Average.....	13.67	.56	12.24	12.80				+ .87	1.50
Third subperiod:									
Total.....	71.62	4.51	63.87	70.38	6.30	91.97	98.27	+ 1.24	10.00
Average.....	14.32	.90	13.17	14.08				+ .24	2.00
Fourth subperiod:									
Total.....	68.80	2.95	64.36	67.31	4.29	93.55	97.83	+ 1.49	12.50
Average.....	13.76	.59	12.87	13.46				+ .30	2.50
Entire preservative period:									
Total.....	280.10	14.57	257.85	272.42	5.20	92.06	97.26	+ 7.68	35.00
Average.....	14.01	.73	12.89	13.62				+ .39	1.75
<i>After period.</i>									
First subperiod:									
Total.....	70.40	4.20	58.42	62.62	5.97	82.98	88.95	+ 7.78	.0
Average.....	14.08	.81	11.68	12.52				+ 1.56	.0
Second subperiod:									
Total.....	66.23	4.28	55.64	59.92	6.46	84.01	90.47	+ 6.31	.0
Average.....	13.25	.86	11.13	11.98				+ 1.25	.0
Entire after period:									
Total.....	136.63	8.48	114.06	122.54	6.21	83.48	89.69	+14.09	.0
Average.....	13.66	.85	11.41	12.25				+ 1.41	.0



TABLE XII.—Nitrogen balances for Series VIII—Continued.

[Averages are per day.]

No. 2.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Balance (1-4).	9 Ben-zoic acid administered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	93.17	6.71	73.13	79.84	7.20	78.49	85.69	+ 13.33	0.0
Average.....	18.63	1.34	14.63	15.97	.....	.....	.....	+ 2.66	.0
Second subperiod:									
Total.....	101.32	7.92	90.25	98.17	7.82	89.07	96.89	+ 3.15	.0
Average.....	20.26	1.58	18.05	19.63	.....	.....	.....	+ .63	.0
Entire fore period:									
Total.....	194.49	14.63	163.38	178.01	7.52	84.00	91.52	+ 16.48	.0
Average.....	19.45	1.46	16.34	17.80	.....	.....	.....	+ 1.65	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	99.76	8.54	88.32	96.86	8.56	88.53	97.09	+ 2.90	5.00
Average.....	19.95	1.71	17.66	19.37	.....	.....	.....	+ .58	1.00
Second subperiod:									
Total.....	97.14	9.30	86.12	95.42	9.57	88.66	98.23	+ 1.72	7.50
Average.....	19.43	1.86	17.22	19.08	.....	.....	.....	+ .35	1.50
Third subperiod:									
Total.....	102.26	9.68	88.47	98.15	9.47	86.51	95.98	+ 4.11	10.00
Average.....	20.45	1.94	17.69	19.63	.....	.....	.....	+ .82	2.00
Fourth subperiod:									
Total.....	92.09	8.78	83.12	91.90	9.53	90.26	99.79	+ .19	2.50
Average.....	18.42	1.76	16.62	18.38	.....	.....	.....	+ .04	.50
Entire preservative period:									
Total.....	391.25	36.30	346.03	382.33	9.28	88.44	97.72	+ 8.92	25.00
Average.....	19.56	1.82	17.30	19.12	.....	.....	.....	+ .44	1.25
<i>After period.</i>									
First subperiod:									
Total.....	92.96	8.81	82.23	91.04	9.48	88.46	97.93	+ 1.92	.0
Average.....	18.59	1.76	16.45	18.21	.....	.....	.....	+ .38	.0
Second subperiod:									
Total.....	92.46	7.76	82.38	90.14	8.39	89.10	97.49	+ 2.32	.0
Average.....	18.49	1.55	16.48	18.03	.....	.....	.....	+ .46	.0
Entire after period:									
Total.....	185.42	16.57	164.61	181.18	8.94	88.78	97.71	+ 4.24	.0
Average.....	18.54	1.66	16.46	18.12	.....	.....	.....	+ .42	.0

TABLE XII.—*Nitrogen balances for Series VIII—Continued.*

[Averages are per day.]

## No. 3.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Balance (1-4).	9 Ben- zoic acid admin- istered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	81.36	5.03	70.97	76.00	6.18	87.23	93.41	+ 5.36	0.0
Average.....	16.27	1.01	14.19	15.20	.....	.....	.....	+ 1.07	.0
Second subperiod:									
Total.....	85.02	4.62	72.29	76.91	5.43	85.03	90.46	+ 8.11	.0
Average.....	17.00	.92	14.46	15.38	.....	.....	.....	+ 1.62	.0
Entire fore period:									
Total.....	166.38	9.65	143.26	152.91	5.80	86.10	91.90	+13.47	.0
Average.....	16.64	.97	14.33	15.29	.....	.....	.....	+ 1.35	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	85.95	6.01	73.51	79.52	6.99	85.53	92.52	+ 6.43	5.00
Average.....	17.19	1.20	14.70	15.90	.....	.....	.....	+ 1.29	1.00
Second subperiod:									
Total.....	87.15	6.48	74.44	80.92	7.44	85.42	92.85	+ 6.23	7.50
Average.....	17.43	1.30	14.89	16.18	.....	.....	.....	+ 1.25	1.50
Third subperiod:									
Total.....	62.78	2.73	71.31	74.04	4.35	113.59	117.94	-11.26	1.00
Average.....	12.56	.55	14.26	14.81	.....	.....	.....	- 2.25	.20
Fourth subperiod:									
Total.....	84.79	6.00	65.51	71.51	7.08	77.26	84.34	+13.28	.0
Average.....	16.96	1.20	13.10	14.30	.....	.....	.....	+ 2.66	.0
Entire preservative period:									
Total.....	320.67	21.22	284.77	305.99	6.62	88.80	95.42	+14.68	13.50
Average.....	16.03	1.06	14.24	15.30	.....	.....	.....	+ .73	.68
<i>After period.</i>									
First subperiod:									
Total.....	88.10	3.46	70.53	73.99	3.93	80.06	83.98	+14.11	.0
Average.....	17.62	.69	14.11	14.80	.....	.....	.....	+ 2.82	.0
Second subperiod:									
Total.....	85.53	3.50	65.77	69.27	4.09	76.89	80.99	+16.26	.0
Average.....	17.11	.70	13.15	13.85	.....	.....	.....	+ 3.26	.0
Entire after period:									
Total.....	173.63	6.96	136.30	143.26	4.01	78.50	82.51	+30.37	.0
Average.....	17.36	.70	13.63	14.33	.....	.....	.....	+ 3.03	.0

TABLE XII.—Nitrogen balances for Series VIII—Continued.

[Averages are per day.]

No. 4.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Bal- ance (1-4).	9 Benzoic acid admin- istered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	69.69	5.11	60.55	65.66	7.33	86.88	94.22	+ 4.03	0.0
Average.....	13.94	1.02	12.11	13.13	.....	.....	.....	+ .81	.0
Second subperiod:									
Total.....	71.36	3.93	70.49	74.42	5.51	98.78	104.29	- 3.06	.0
Average.....	14.27	.79	14.10	14.89	.....	.....	.....	- .62	.0
Entire fore period:									
Total.....	141.05	9.04	131.04	140.08	6.41	92.90	99.31	+ .97	.0
Average.....	14.11	.90	13.10	14.01	.....	.....	.....	+ .10	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	71.35	4.52	67.96	72.48	6.33	95.25	101.58	- 1.13	5.00
Average.....	14.27	.90	13.59	14.49	.....	.....	.....	- .22	1.00
Second subperiod:									
Total.....	69.27	4.21	63.11	67.32	6.08	91.11	97.18	+ 1.95	7.50
Average.....	13.85	.84	12.62	13.46	.....	.....	.....	+ .39	1.50
Third subperiod:									
Total.....	73.13	4.06	61.66	65.72	5.55	84.32	89.87	+ 7.41	10.00
Average.....	14.63	.81	12.33	13.14	.....	.....	.....	+ 1.49	2.00
Fourth subperiod:									
Total.....	69.93	4.63	61.93	66.56	6.62	88.56	95.18	+ 3.37	12.50
Average.....	13.99	.93	12.39	13.31	.....	.....	.....	+ .68	2.50
Entire preservative period:									
Total.....	283.68	17.42	254.66	272.08	6.14	89.77	95.88	+11.60	35.00
Average.....	14.18	.87	12.73	13.60	.....	.....	.....	+ .58	1.75
<i>After period.</i>									
First subperiod:									
Total.....	70.77	4.75	70.45	75.20	6.71	99.55	106.26	- 4.43	.0
Average.....	14.15	.95	14.09	15.04	.....	.....	.....	- .89	.0
Second subperiod:									
Total.....	68.61	3.88	59.79	63.67	5.66	87.14	92.80	+ 4.94	.0
Average.....	13.72	.78	11.96	12.73	.....	.....	.....	+ .99	.0
Entire after period:									
Total.....	139.38	8.63	130.24	138.87	6.19	93.44	99.63	+ .51	.0
Average.....	13.94	.86	13.02	13.89	.....	.....	.....	+ .05	.0

TABLE XII.—*Nitrogen balances for Series VIII—Continued.*

[Averages are per day.]

No. 5.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Balance (1-4).	9 Ben- zoic acid admin- istered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	52.15	2.87	<sup>a</sup> 41.86	44.73	5.50	80.27	85.77	+ 7.42	0.0
Average.....	10.43	.57	8.37	8.95	.....	.....	.....	+ 1.48	.0
Second subperiod:									
Total.....	55.47	4.78	42.34	47.12	8.62	76.33	84.95	+ 8.35	.0
Average.....	11.09	.96	8.47	9.42	.....	.....	.....	+ 1.67	.0
Entire fore period:									
Total.....	107.62	7.65	84.20	91.85	7.11	78.24	85.35	+15.77	.0
Average.....	10.76	.76	8.42	9.19	.....	.....	.....	+ 1.58	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	55.07	5.39	44.43	49.82	9.76	80.68	90.47	+ 5.25	5.06
Average.....	11.01	1.08	8.89	9.96	.....	.....	.....	+ 1.05	1.00
Second subperiod:									
Total.....	55.49	4.39	<sup>a</sup> 49.62	54.01	7.91	89.42	97.33	+ 1.48	7.50
Average.....	11.10	.88	9.92	10.80	.....	.....	.....	+ .30	1.50
Third subperiod:									
Total.....	58.55	4.85	53.63	58.48	8.28	91.60	99.88	+ .07	8.00
Average.....	11.71	.97	10.73	11.70	.....	.....	.....	+ .01	1.60
Fourth subperiod:									
Total.....	53.94	5.95	<sup>a</sup> 44.11	50.06	11.03	81.78	92.99	+ 3.88	3.00
Average.....	10.79	1.19	8.82	10.01	.....	.....	.....	+ .78	2.66
Entire preservative period:									
Total.....	223.05	20.58	191.79	212.37	9.23	85.99	95.21	+10.68	23.56
Average.....	11.15	1.03	9.59	10.62	.....	.....	.....	+ .53	1.18
<i>After period.</i>									
First subperiod:									
Total.....	56.20	6.04	<sup>a</sup> 45.52	51.56	10.75	81.00	91.74	+ 4.64	.0
Average.....	11.24	1.21	9.10	10.31	.....	.....	.....	+ .93	.0
Second subperiod:									
Total.....	56.68	3.88	41.81	45.69	6.85	73.76	80.61	+10.99	.0
Average.....	11.34	.78	8.36	9.14	.....	.....	.....	+ 2.20	.0
Entire after period:									
Total.....	112.88	9.92	87.33	97.25	8.79	77.37	86.15	+15.63	.0
Average.....	11.29	.99	8.73	9.73	.....	.....	.....	+ 1.56	.0

<sup>a</sup> Daily average added to complete record.



TABLE XII.—*Nitrogen balances for Series VIII—Continued.*

[Averages are per day.]

No. 6.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Bal- ance (1-4).	9 Ben- zoic acid admin- istered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	74.49	9.94	66.55	76.49	13.34	89.34	102.68	-2.00	0.0
Average.....	14.90	1.99	13.31	15.30	.....	.....	.....	- .40	.0
Second subperiod:									
Total.....	81.46	8.53	69.15	77.68	10.47	84.89	95.36	+3.78	.0
Average.....	16.29	1.71	13.83	15.54	.....	.....	.....	+ .75	.0
Entire fore period:									
Total.....	155.95	18.47	135.70	154.17	11.84	87.02	98.86	+1.78	.0
Average.....	15.60	1.85	13.57	15.42	.....	.....	.....	+ .18	.....
<i>Preservative period.</i>									
First subperiod:									
Total.....	81.92	9.03	64.24	73.27	11.02	78.42	89.44	+8.65	5.00
Average.....	16.38	1.81	12.85	14.65	.....	.....	.....	+1.73	1.00
Second subperiod:									
Total.....	78.18	6.76	66.18	72.94	8.65	84.65	93.30	+5.24	7.50
Average.....	15.64	1.35	13.24	14.59	.....	.....	.....	+1.05	1.50
Third subperiod:									
Total.....	78.12	8.24	65.09	73.33	10.55	83.32	93.87	+4.79	10.00
Average.....	15.62	1.65	13.02	14.67	.....	.....	.....	+ .95	2.00
Fourth subperiod:									
Total.....	72.36	6.78	63.52	70.30	9.37	87.78	97.15	+2.06	.0
Average.....	14.47	1.36	12.70	14.06	.....	.....	.....	+ .41	.0
Entire preservative period:									
Total.....	310.58	30.81	259.03	289.84	9.92	83.40	93.32	+20.74	22.50
Average.....	15.53	1.54	12.95	14.49	.....	.....	.....	+ 1.04	1.13
<i>After period.</i>									
First subperiod:									
Total.....	74.61	8.39	64.87	73.26	11.25	86.95	98.19	+ 1.35	.0
Average.....	14.92	1.68	12.97	14.65	.....	.....	.....	+ .27	.0
Second subperiod:									
Total.....	<sup>a</sup> 77.16	<sup>a</sup> 3.79	<sup>a</sup> 60.46	64.25	4.91	78.36	83.27	+12.91	.0
Average.....	15.43	.76	12.09	12.85	.....	.....	.....	+ 2.58	.0
Entire after period:									
Total.....	151.77	12.18	125.33	137.51	8.03	82.58	90.60	+14.26	.0
Average.....	15.18	1.22	12.53	13.75	.....	.....	.....	+ 1.43	.0

<sup>a</sup> Daily average added to complete record.

TABLE XII.—*Nitrogen balances for Series VIII—Continued.*

[Averages are per day.]

No. 7.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2÷3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Bal- ance (1-4).	9 Sodium benzo- ate ad- minis- tered (calcu- lated as ben- zoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	69.40	6.27	62.01	68.28	9.03	89.35	98.39	+ 1.12	0.0
Average.....	13.88	1.25	12.40	13.66				+ .22	.0
Second subperiod:									
Total.....	74.58	5.94	61.92	67.86	7.96	83.02	90.99	+ 6.72	.0
Average.....	14.92	1.19	12.38	13.57				+ 1.35	.0
Entire fore period:									
Total.....	143.98	12.21	123.93	136.14	8.48	86.07	94.55	+ 7.84	.0
Average.....	14.40	1.22	12.39	13.61				+ .79	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	73.30	5.47	61.95	67.42	7.46	84.52	91.98	+ 5.88	4.90
Average.....	14.66	1.09	12.39	13.48				+ 1.18	.98
Second subperiod:									
Total.....	71.04	6.86	55.96	68.82	9.66	78.77	88.43	+ 8.22	7.50
Average.....	14.21	1.37	11.19	12.56				+ 1.65	1.50
Third subperiod:									
Total.....	75.24	4.89	54.17	59.06	6.50	72.00	78.51	+16.18	10.00
Average.....	15.05	.98	10.83	11.87				+ 3.24	2.00
Fourth subperiod:									
Total.....	66.67	5.11	60.72	65.83	7.66	91.08	98.74	+ .84	6.50
Average.....	13.33	1.02	12.14	13.17				+ .16	1.30
Entire preservative period:									
Total.....	286.25	22.33	232.80	255.13	7.80	81.33	89.13	+31.12	28.90
Average.....	14.31	1.12	11.64	12.76				+ 1.55	1.45
<i>After period.</i>									
First subperiod:									
Total.....	69.23	6.21	59.94	57.15	8.97	73.58	82.55	+12.08	.0
Average.....	13.85	1.24	10.19	11.43				+ 2.42	.0
Second subperiod:									
Total.....	65.22	7.71	53.80	61.51	11.82	82.49	94.31	+ 3.71	.0
Average.....	13.04	1.54	10.76	12.30				+ .74	.0
Entire after period:									
Total.....	134.45	13.92	104.74	118.66	10.35	77.90	88.26	+15.79	.0
Average.....	13.45	1.39	10.47	11.87				+ 1.58	.0

TABLE XII.—*Nitrogen balances for Series VIII—Continued.*

[Averages are per day.]

No. 8.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Balance (1-4).	9 Sodium benzoate administered (calculated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	64.26	9.25	55.38	64.63	14.39	86.18	100.58	-0.37	0.0
Average.....	12.85	1.85	11.08	12.93	.....	.....	.....	-.08	.0
Second subperiod:									
Total.....	68.94	3.53	59.68	63.21	5.12	86.56	91.69	+5.73	.0
Average.....	13.79	.71	11.94	12.64	.....	.....	.....	+1.15	.0
Entire fore period:									
Total.....	133.20	12.78	115.06	127.84	9.59	86.38	95.98	+5.36	.0
Average.....	13.32	1.28	11.51	12.78	.....	.....	.....	+ .54	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	70.12	8.38	62.47	70.85	11.95	89.09	101.04	-.73	4.90
Average.....	14.02	1.68	12.49	14.17	.....	.....	.....	-.15	.98
Second subperiod:									
Total.....	66.97	7.35	<sup>a</sup> 61.29	68.64	10.98	91.52	102.49	-1.67	7.50
Average.....	13.39	1.47	12.26	13.73	.....	.....	.....	-.34	1.50
Third subperiod:									
Total.....	70.02	7.35	58.88	66.23	10.50	84.09	94.59	+3.79	10.00
Average.....	14.00	1.47	11.78	13.25	.....	.....	.....	+ .75	2.00
Fourth subperiod:									
Total.....	68.62	7.73	61.29	69.02	11.26	89.31	100.58	-.40	12.50
Average.....	13.72	1.55	12.26	13.80	.....	.....	.....	-.08	2.50
Entire preservative period:									
Total.....	275.73	30.81	243.93	274.74	11.17	88.47	99.64	+ .99	34.90
Average.....	13.79	1.54	12.20	13.74	.....	.....	.....	+ .05	1.75
<i>After period.</i>									
First subperiod:									
Total.....	69.58	7.96	62.19	70.15	11.44	89.38	100.82	-.57	.0
Average.....	13.92	1.59	12.44	14.03	.....	.....	.....	-.11	.0
Second subperiod:									
Total.....	66.60	8.48	62.39	70.87	12.73	93.68	106.41	-4.27	.0
Average.....	13.32	1.70	12.48	14.17	.....	.....	.....	-.85	.0
Entire after period:									
Total.....	136.18	16.44	124.58	141.02	12.07	91.48	103.55	-4.84	.0
Average.....	13.62	1.64	12.46	14.10	.....	.....	.....	-.48	.0

<sup>a</sup> Daily average added to complete record.

TABLE XII.—*Nitrogen balances for Series VIII*—Continued.

[Averages are per day.]

No. 9.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Balance (1-4).	9 Sodium benzoate administered (calculated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	77.48	5.17	<sup>a</sup> 68.98	74.15	6.67	89.03	95.70	+ 3.33	0.0
Average.....	15.50	1.03	13.80	14.83				+ .67	.0
Second subperiod:									
Total.....	85.13	4.52	68.46	72.98	5.31	80.42	85.73	+12.15	.0
Average.....	17.03	.90	13.69	14.60				+ 2.43	.0
Entire fore period:									
Total.....	162.61	9.69	137.44	147.13	5.96	84.52	90.48	+15.48	.0
Average.....	16.26	.97	13.74	14.71				+ 1.55	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	83.84	2.30	<sup>a</sup> 70.62	72.92	2.74	84.23	86.98	+10.92	4.90
Average.....	16.77	.46	14.12	14.58				+ 2.19	.98
Second subperiod:									
Total.....	82.29	4.80	64.96	69.76	5.83	78.94	84.77	+12.53	7.50
Average.....	16.46	.96	12.99	13.95				+ 2.51	1.50
Third subperiod:									
Total.....	85.01	2.23	75.70	77.93	2.62	89.05	91.67	+ 7.08	10.00
Average.....	17.00	.45	15.14	15.59				+ 1.41	2.00
First, second, and third subperiods:									
Total.....	251.14	9.33	211.28	220.61	3.73	84.53	88.27	+30.53	22.40
Average.....	16.74	.62	14.09	14.71				+ 2.03	<sup>b</sup> 1.12
<i>After period.</i>									
First subperiod:									
Total.....	84.43	4.64	71.30	75.94	5.50	84.45	89.94	+ 8.49	.0
Average.....	16.89	.93	14.26	15.19				+ 1.70	.0
Second subperiod:									
Total.....	81.95	6.40	73.17	79.57	7.81	89.29	97.10	+ 2.38	.0
Average.....	16.39	1.28	14.63	15.91				+ .48	.0
Entire after period:									
Total.....	166.38	11.04	144.47	155.51	6.64	86.83	93.47	+10.87	.0
Average.....	16.64	1.10	14.45	15.55				+ 1.09	.0

<sup>a</sup> Daily average added to complete record.<sup>b</sup> Average for 20 days.



TABLE XII.—*Nitrogen balances for Series VIII*—Continued.

[Averages are per day.]

No. 10.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Balance (1-4).	9 Sodium benzoate administered (calculated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	74.92	6.28	53.83	60.11	8.38	71.85	80.23	+14.81	0.0
Average.....	14.98	1.26	10.77	12.02	.....	.....	.....	+ 2.96	.0
Second subperiod:									
Total.....	82.23	3.33	57.82	61.15	4.05	74.31	74.36	+21.08	.0
Average.....	16.44	.67	11.56	12.23	.....	.....	.....	+ 4.21	.0
Entire fore period:									
Total.....	157.15	9.61	111.65	121.26	6.12	71.05	77.16	+35.89	.0
Average.....	15.72	.96	11.17	12.13	.....	.....	.....	+ 3.59	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	80.94	3.26	67.57	70.83	4.03	83.48	87.51	+10.11	4.90
Average.....	16.19	.65	13.51	14.17	.....	.....	.....	+ 2.02	.98
Second subperiod:									
Total.....	78.12	9.15	a 62.75	71.90	11.71	80.33	92.04	+ 6.22	7.50
Average.....	15.62	1.83	12.55	14.38	.....	.....	.....	+ 1.24	1.50
Third subperiod:									
Total.....	72.51	4.84	54.46	59.30	6.67	75.11	81.78	+13.21	8.00
Average.....	14.50	.97	10.89	11.86	.....	.....	.....	+ 2.64	1.60
Fourth subperiod:									
Total.....	60.28	4.06	48.25	52.31	6.74	80.04	86.78	+ 7.97	.0
Average.....	12.06	.81	9.65	10.46	.....	.....	.....	+ 1.60	.0
Entire preservative period:									
Total.....	291.85	21.31	233.03	254.34	7.50	79.85	87.15	+37.51	20.40
Average.....	14.59	1.07	11.15	12.72	.....	.....	.....	+ 1.87	1.02
<i>After period.</i>									
First subperiod:									
Total.....	80.86	6.27	58.99	65.26	7.75	72.95	80.71	+15.60	.0
Average.....	16.17	1.25	11.80	13.05	.....	.....	.....	+ 3.12	.0
Second subperiod:									
Total.....	69.45	6.10	54.31	60.41	8.78	78.20	86.98	+ 9.04	.0
Average.....	13.89	1.22	10.86	12.08	.....	.....	.....	+ 1.81	.0
Entire after period:									
Total.....	150.31	12.37	113.30	125.67	8.23	75.38	83.61	+24.64	.0
Average.....	15.03	1.24	11.33	12.57	.....	.....	.....	+ 2.46	.0

a Daily average added to complete record.

TABLE XII.—*Nitrogen balances for Series VIII*—Continued.

[Averages are per day.]

## No. 11.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Balance (1-4).	9 Sodium ben- zoate admin- istered (calcu- lated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	83.00	4.70	71.23	75.93	5.66	85.82	91.48	+ 7.07	0 0
Average.....	16.60	.94	14.25	15.19				+ 1.41	.0
Second subperiod:									
Total.....	93.14	5.22	69.08	74.30	5.60	74.16	79.76	+18.84	.0
Average.....	18.63	1.04	13.82	14.86				+ 3.77	.0
Entire fore period:									
Total.....	176.14	9.92	140.31	150.23	5.63	79.66	85.29	+25.91	.0
Average.....	17.61	.99	14.03	15.02				+ 2.59	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	93.74	7.94	81.41	89.35	8.47	86.85	95.32	+ 4.39	4.90
Average.....	18.75	1.59	16.28	17.87				+ .88	.98
Second subperiod:									
Total.....	86.28	7.59	67.67	75.26	8.80	78.43	87.23	+11.02	7.50
Average.....	17.26	1.52	13.53	15.05				+ 2.21	1.50
Third subperiod:									
Total.....	94.65	4.77	84.01	88.78	5.04	88.76	93.80	+ 5.87	10.00
Average.....	18.93	.95	16.80	17.76				+ 1.17	2.00
Fourth subperiod:									
Total.....	82.02	6.37	7.782	85.09	7.77	95.98	103.74	- 3.07	2.50
Average.....	16.40	1.27	15.74	17.02				- .62	.50
Entire preservative period:									
Total.....	356.69	26.67	311.81	338.48	7.48	87.42	94.89	+18.21	24.90
Average.....	17.83	1.33	15.59	16.92				+ .91	1.25
<i>After period.</i>									
First subperiod:									
Total.....	92.60	7.07	72.07	79.14	7.63	77.83	85.46	+13.46	.0
Average.....	18.52	1.41	14.41	15.83				+ 2.69	.0
Second subperiod:									
Total.....	88.58	6.35	75.40	81.75	7.17	85.12	92.29	+ 6.83	.0
Average.....	17.72	1.27	15.08	16.35				+ 1.37	.0
Entire after period:									
Total.....	181.18	13.42	147.47	160.89	7.41	81.39	88.80	+20.29	.0
Average.....	18.12	1.34	14.75	16.09				+ 2.03	.0

TABLE XII.—*Nitrogen balances for Series VIII—Continued.*

[Averages are per day.]

## No. 12.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Balance (1-4).	9 Sodium benzoate administered (calculated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	86.27	6.71	62.96	69.67	7.78	72.98	80.76	+16.60	0.0
Average.....	17.25	1.34	12.59	13.93				+ 3.32	.0
Second subperiod:									
Total.....	92.80	5.11	68.27	73.38	5.51	73.57	79.07	+19.42	.0
Average.....	18.56	1.02	13.65	14.68				+ 3.88	.0
Entire fore period:									
Total.....	179.07	11.82	131.23	143.05	6.60	73.28	79.88	+36.02	.0
Average.....	17.91	1.18	13.12	14.31				+ 3.60	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	93.32	5.38	75.79	81.17	5.77	81.22	86.98	+12.15	4.90
Average.....	18.66	1.08	15.16	16.23				+ 2.43	.98
Second subperiod:									
Total.....	89.46	4.52	71.38	75.90	5.05	79.79	84.84	+13.56	7.50
Average.....	17.89	.90	14.28	15.18				+ 2.71	1.50
Third subperiod:									
Total.....	89.64	4.93	71.59	76.52	5.50	79.86	85.36	+13.12	10.00
Average.....	17.93	.99	14.32	15.30				+ 2.63	2.00
Fourth subperiod:									
Total.....	71.21	7.46	61.37	68.83	10.48	86.18	96.66	+ 2.38	.0
Average.....	14.24	1.49	12.27	13.77				+ .47	.0
Entire preservative period:									
Total.....	343.63	22.29	280.13	302.42	6.49	81.52	88.01	+41.21	22.40
Average.....	17.18	1.11	14.00	15.12				+ 2.06	1.12
<i>After period.</i>									
First subperiod:									
Total.....	80.75	5.94	62.92	68.86	7.36	77.92	85.28	+11.89	.0
Average.....	16.15	1.19	12.58	13.77				+ 2.38	.0
Second subperiod:									
Total.....	76.25	5.94	58.59	64.53	7.79	76.84	84.63	+11.72	.0
Average.....	15.25	1.19	11.72	12.91				+ 2.34	.0
Entire after period:									
Total.....	157.00	11.88	121.51	133.39	7.57	77.39	84.96	+23.61	.0
Average.....	15.70	1.19	12.15	13.34				+ 2.36	.0

TABLE XII.—*Nitrogen balances for Series VIII*—Continued.

## SUMMARIES.

[Averages are per man per day.]

Nos. 1 and 4.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Balance (1-4).	9 Ben- zoic acid admin- istered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	134.39	7.77	118.81	126.58	5.78	88.41	94.19	+ 7.81	0.0
Average.....	13.44	.78	11.88	12.66	.....	.....	.....	+ .78	.0
Second subperiod:									
Total.....	142.96	8.06	136.42	144.48	5.64	95.43	101.06	- 1.52	.0
Average.....	14.30	.81	13.64	14.45	.....	.....	.....	- .15	.0
Entire fore period:									
Total.....	277.35	15.83	255.23	271.06	5.71	92.02	97.73	+ 6.29	.0
Average.....	13.87	.79	12.76	13.55	.....	.....	.....	+ .32	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	142.68	8.82	134.40	143.22	6.18	94.20	100.38	- .54	10.00
Average.....	14.27	.88	13.44	14.32	.....	.....	.....	- .05	1.00
Second subperiod:									
Total.....	137.62	7.02	124.29	131.31	5.10	90.31	95.41	+ 6.31	15.00
Average.....	13.76	.70	12.43	13.13	.....	.....	.....	+ .63	1.50
Third subperiod:									
Total.....	144.75	8.57	127.53	136.10	5.92	88.10	94.02	+ 8.65	20.00
Average.....	14.48	.86	12.75	13.61	.....	.....	.....	+ .87	2.00
Fourth subperiod:									
Total.....	138.73	7.58	126.29	133.87	5.46	91.03	96.50	+ 4.86	25.00
Average.....	13.87	.76	12.63	13.39	.....	.....	.....	+ .48	2.50
Entire preservative period:									
Total.....	563.78	31.99	512.51	544.50	5.67	90.91	96.58	+19.28	70.00
Average.....	14.10	.80	12.81	13.61	.....	.....	.....	+ .49	1.75
<i>After period.</i>									
First subperiod:									
Total.....	141.17	8.95	128.87	137.82	6.34	91.29	97.63	+ 3.35	.0
Average.....	14.12	.90	12.89	13.78	.....	.....	.....	+ .34	.0
Second subperiod:									
Total.....	134.84	8.16	115.43	123.59	6.05	85.61	91.66	+11.25	.0
Average.....	13.48	.82	11.54	12.36	.....	.....	.....	+ 1.12	.0
Entire after period:									
Total.....	276.01	17.11	244.30	261.41	6.20	88.51	94.71	+14.60	.0
Average.....	13.80	.86	12.22	13.07	.....	.....	.....	+ .73	.0



TABLE XII.—*Nitrogen balances for Series VIII—Continued.*

## SUMMARIES—Continued.

[Averages are per man per day.]

Nos. 1, 2, 4, 5, and 6.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Balance (1-4).	9 Ben- zoic acid ad- minis- tered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	354.20	27.29	300.35	327.64	7.70	84.80	92.50	26.56	0.0
Average.....	14.17	1.09	12.01	13.10	.....	.....	.....	1.07	.0
Second subperiod:									
Total.....	381.21	29.29	338.16	367.45	7.68	88.71	96.39	13.76	.0
Average.....	15.25	1.17	13.53	14.70	.....	.....	.....	.55	.0
Entire fore period:									
Total.....	735.41	56.58	638.51	695.09	7.69	86.82	94.52	40.32	.0
Average.....	14.71	1.13	12.77	13.90	.....	.....	.....	.81	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	379.43	31.78	331.39	363.17	8.36	87.34	95.71	16.26	25.00
Average.....	15.18	1.27	13.26	14.53	.....	.....	.....	.65	1.00
Second subperiod:									
Total.....	368.43	27.47	326.21	353.68	7.46	88.54	96.00	14.75	37.50
Average.....	14.74	1.10	13.05	14.15	.....	.....	.....	.59	1.50
Third subperiod:									
Total.....	383.68	31.34	334.72	366.06	8.17	87.24	95.41	17.62	48.00
Average.....	15.35	1.25	13.39	14.64	.....	.....	.....	.71	1.92
First, second, and third subperiods:									
Total.....	1,131.54	90.59	992.32	1,082.91	8.01	87.70	95.70	48.63	110.50
Average.....	15.09	1.21	13.23	14.44	.....	.....	.....	.65	1.47
<i>After period.</i>									
First subperiod:									
Total.....	364.94	32.19	321.49	353.68	8.82	88.09	96.91	11.26	.0
Average.....	14.60	1.29	12.86	14.15	.....	.....	.....	.45	.0
Second subperiod:									
Total.....	361.14	23.59	300.08	323.67	6.53	83.09	89.62	37.47	.0
Average.....	14.44	.94	12.00	12.94	.....	.....	.....	1.50	.0
Entire after period:									
Total.....	726.08	55.78	621.57	677.35	7.68	85.61	93.29	48.73	.0
Average.....	14.52	1.12	12.43	13.55	.....	.....	.....	.97	.0

TABLE XII.—*Nitrogen balances for Series VIII*—Continued.

## SUMMARIES—Continued.

[Averages are per man per day.]

Nos. 7 to 12.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Balance (1-4).	9 Sodium benzoate administered (calculated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	455.33	38.38	374.39	412.77	8.43	82.23	90.65	42.56	0.0
Average.....	15.18	1.28	12.48	13.76				1.42	.0
Second subperiod:									
Total.....	496.82	27.65	385.23	412.88	5.57	77.54	83.11	83.94	.0
Average.....	16.56	.92	12.84	13.76				2.80	.0
Entire fore period:									
Total.....	952.15	66.03	759.62	825.65	6.93	79.78	86.71	126.50	.0
Average.....	15.87	1.10	12.66	13.76				2.11	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	495.26	32.73	419.81	452.54	6.61	84.77	91.37	42.72	29.40
Average.....	16.51	1.09	13.99	15.08				1.43	.98
Second subperiod:									
Total.....	474.16	40.27	384.01	424.28	8.49	80.99	89.48	49.88	45.00
Average.....	15.80	1.34	12.80	14.14				1.66	1.50
Third subperiod:									
Total.....	487.07	29.01	398.81	427.82	5.96	81.88	87.84	59.25	58.00
Average.....	16.24	.97	13.29	14.26				1.98	1.93
First, second, and third subperiods:									
Total.....	1,456.49	102.01	1,202.63	1,304.64	7.00	82.57	89.57	151.85	132.40
Average.....	16.18	1.13	13.36	14.49				1.69	1.47
<i>After period.</i>									
First subperiod:									
Total.....	477.45	38.09	378.41	416.50	7.98	79.26	87.23	60.95	.0
Average.....	15.85	1.27	12.61	13.88				1.97	.0
Second subperiod:									
Total.....	448.05	40.98	377.06	418.64	9.15	84.29	93.44	29.41	.0
Average.....	14.94	1.37	12.59	13.96				.98	.0
Entire after period:									
Total.....	925.50	79.07	756.07	835.14	8.54	81.69	90.24	90.36	.0
Average.....	15.43	1.32	12.60	13.92				1.51	.0

TABLE XII.—*Nitrogen balances for Series VIII—Continued.*

## SUMMARIES—Continued.

[Averages are per man per day.]

Nos. 1 to 12, omitting No. 3.

Period.	1	2	3	4	5	6	7	8	9
	In food.	In feces.	In urine.	In feces and urine (2+3).	In feces (2÷1).	In urine (3÷1).	In feces and urine (4÷1).	Balance (1-4).	Pre-servative calculated as benzoic acid.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams</i>
Total.....	809.53	65.67	674.74	740.41	8.11	83.35	91.46	69.12	0.0
Average.....	14.72	1.19	12.27	13.46				1.26	.0
Second subperiod:									
Total.....	878.03	56.94	723.39	780.33	6.48	82.39	88.87	97.70	.0
Average.....	15.96	1.04	13.15	14.19				1.77	.0
Entire fore period:									
Total.....	1,687.56	122.61	1,398.13	1,520.74	7.26	82.85	90.11	166.82	.0
Average.....	15.34	1.11	12.71	13.82				1.52	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	874.69	64.51	751.20	815.71	7.38	85.88	93.26	58.98	54.40
Average.....	15.90	1.17	13.66	14.83				1.07	.99
Second subperiod:									
Total.....	842.59	67.74	710.22	777.96	8.04	84.29	92.33	64.63	82.50
Average.....	15.32	1.23	12.91	14.14				1.18	1.50
Third subperiod:									
Total.....	870.75	60.35	733.53	793.88	6.93	84.24	91.17	76.87	106.00
Average.....	15.83	1.10	13.33	14.43				1.40	1.93
First, second, and third subperiods:									
Total.....	2,588.03	192.60	2,194.95	2,387.55	7.44	84.81	92.25	200.48	242.90
Average.....	15.69	1.17	13.30	14.47				1.22	1.47
<i>After period.</i>									
First subperiod:									
Total.....	842.39	70.28	699.90	770.18	8.34	83.09	91.43	72.21	.0
Average.....	15.32	1.28	12.73	14.01				1.31	.0
Second subperiod:									
Total.....	809.19	64.57	677.74	742.31	7.98	83.76	91.73	66.88	.0
Average.....	14.71	1.17	12.32	13.49				1.22	.0
Entire after period:									
Total.....	1,651.58	134.85	1,377.64	1,512.49	8.16	83.41	91.58	139.09	.0
Average.....	15.01	1.23	12.52	13.75				1.26	.0

## PHOSPHORIC ACID BALANCE.

## INDIVIDUAL DATA.

## No. 1.

No. 1 in the fore period shows some abnormal activity in the excretion of phosphoric acid inasmuch as the balance is negative. The normal condition is restored in the preservative period where the quantity of phosphoric acid excreted in the urine is less than in the fore period. In the after period there is a still further diminution of the phosphoric acid excreted in the urine; and the balance becomes strongly positive

## No. 2.

In the case of No. 2, the quantity of phosphoric acid excreted in the feces during the preservative period is notably greater, notwithstanding a slight decrease in the amount ingested, with the result that the percentage excretion increases 9.29 per cent. It is somewhat diminished in the after period, as is also the amount ingested, but does not fall to the quantity of the fore period, being still 6.66 per cent greater than in that period. The quantity of phosphoric acid excreted in the urine remains practically constant throughout the three periods, increasing about 1 per cent in the preservative period. The balances are positive in all cases and amount to 0.711, 0.173, and 0.333 gram daily for the three periods, respectively, the decrease of 0.538 being due almost entirely to the increased excretion of nonmetabolized phosphoric acid.

## No. 3.

In the case of No. 3, the quantity of phosphoric acid excreted in the feces is very notably increased in the preservative period, while in the after period it falls below that of the fore period, amounting to a loss of 5.70 per cent. The quantity excreted in the urine increases but little in actual amount (0.171 gram daily), the amount ingested decreases slightly, and the percentage increase of metabolized phosphoric acid excreted is 6.34. The balance is positive and its magnitude is 0.839 gram, 0.112 gram, and 1.169 grams daily for the three periods, the decrease again being largely due to the amount of nonmetabolized phosphoric acid excreted.

## No. 4.

In the case of No. 4, there is a decrease in the quantity of phosphoric acid excreted in the feces in the preservative period, while in the after period the amount rises to a somewhat larger figure than in the fore period. There is a decrease also in the quantity of phosphoric acid excreted in the urine in the preservative period and a further decrease in the after period. As in the previous cases, there is a slight decrease in the phosphoric acid ingested throughout. The balances are positive in all cases and their magnitudes are 0.258, 0.340, and 0.428 gram daily for the three periods, respectively. This is contrary to the two previous cases, in which a marked decrease in balance occurred.

## No. 5.

There is an increase in the case of No. 5 of 0.173 gram daily in the quantity of phosphoric acid excreted in the feces in the preservative period, and this increase remains about the same in the after period.



The quantities of phosphoric acid excreted in the urine are remarkably constant for the three periods. In this case the phosphoric acid ingested increased slightly throughout. The percentage of phosphoric acid excreted in the feces and urine increases almost 4 per cent in the preservative period, returning to practically the figure of the fore period in the after period. The balances are positive in all cases and their magnitudes are 0.574 gram, 0.472 gram, and 0.632 gram daily for the three periods, respectively. Again the decrease in balance is due to the increase in excretion of non-metabolized phosphoric acid (5.35 per cent), there being in this case no appreciable change in the phosphoric acid eliminated in the urine.

*No. 6.*

The data for No. 6 show a decrease in the quantity of phosphoric acid excreted in the feces during the preservative period and a still further decrease in the after period. The quantity excreted in the urine during the three periods remains remarkably constant, which is also true of the amounts ingested. The balances are positive in all cases and their values are 0.341 gram, 0.483 gram, and 0.581 gram daily for the three periods. Again there is a slight increase in the balance, as in the case of No. 4.

*No. 7.*

In the case of No. 7 there is again a decrease in the quantity of phosphoric acid excreted in the feces in the preservative period, while in the after period the amount is larger than in the fore period. A notable decrease is found in the amount of phosphoric acid in the urine, both in the preservative and after periods. There is a slight continuous decrease in the amount of phosphoric acid ingested and the percentage decrease in total elimination amounts to 10.12 per cent, the actual decrease being 0.442 gram daily, while the decrease in the amount ingested was only 0.154 gram. The balances are positive and their values are 0.062 gram, 0.350 gram, and 0.139 gram daily for the three periods, respectively, showing a marked increase in the balance in the preservative period, notwithstanding the slight decrease in the amount ingested.

*No. 8.*

In the case of No. 8 an increase is shown in the quantity of phosphoric acid excreted in the feces both in the preservative and after periods. There is also a slight increase in the quantity of phosphoric acid excreted in the urine during the preservative period, followed by a slight decrease in the after period. The amounts ingested remain practically constant throughout. The percentage data show an increase of 5.19 per cent in nonmetabolized phosphoric acid and of

2.10 per cent of phosphoric acid in the urine in the preservative period, and the magnitudes of the balances are 0.350 gram, 0.121 gram, and 0.167 gram daily for the three periods. This decrease of 0.229 gram per day in the preservative period, as in the previous cases, is due to the increased excretion of nonmetabolized phosphoric acid.

*No. 9.*

In the case of No. 9 there is a notable decrease (0.393 gram daily) in the excretion of phosphoric acid in the feces during the preservative period. There is, however, an almost equal increase in the amount excreted in the after period as compared with the fore period. The quantity of phosphoric acid excreted in the urine decreases slightly both in the preservative and after periods. The percentage decrease in total elimination is 12.04, apparently an abnormal figure, especially as in the after period there is an increase of 3.49 per cent as compared with the fore period. The balances are all positive, and by reason of the abnormal condition just mentioned the figure for the preservative period is very high, showing an increase of 0.473. The balances for the three periods respectively are 0.354 gram, 0.827 gram, and 0.205 gram daily.

*No. 10.*

No. 10 shows a slight increase in the excretion of phosphoric acid in the feces in the preservative period and a marked increase in the after period. The quantity of phosphoric acid excreted in the urine does not vary greatly in the three periods, but decreases very slightly throughout. The amount of phosphoric acid ingested decreases in the preservative period 0.239 gram daily with the result that the percentage excretion both in the feces and urine increases slightly, the total increase amounting to 2.45 per cent. The balances are all high and positive and their values are 0.932 gram, 0.788 gram, and 0.597 gram daily for the three periods respectively.

*No. 11.*

The data for No. 11 show a notable increase in the quantity of phosphoric acid excreted in the feces in the preservative period and this increase is maintained in the after period. The quantity of phosphoric acid excreted in the urine shows practically no variation in the fore and preservative periods and is slightly less in the after period. The amounts of phosphoric acid ingested are practically constant, decreasing only 0.098 gram in the preservative period. The percentage figures show an increase of 8.97 per cent in nonmetabolized phosphoric acid and of only 2.73 per cent in the phosphoric acid in the urine. The balances are positive and high, amounting to 1.104 grams, 0.548 gram, and 0.939 gram daily for the three periods, the

decrease in the balance in the preservative period being again accounted for by the increase in the excretion of the phosphoric acid in the feces.

*No. 12.*

In the case of No. 12, there is a decrease in the quantity of phosphoric acid excreted in the feces in the preservative period and this decrease is still continued in the after period. The quantities of phosphoric acid excreted in the urine are almost the same for the fore and preservative periods and slightly less in the after period. The phosphoric acid ingested also decreased slightly throughout the observation and the percentage data show a decrease of 2.91 per cent of nonmetabolized phosphoric acid in the preservative period and an increase of 4.2 per cent of metabolized phosphoric acid.

SUMMARIES.

The summary for Nos. 1 and 4 is of interest only because these members were able to take the preservative throughout the fourth subperiod, and, therefore, the data can be summarized for the entire period of observation. The amounts of phosphoric acid ingested were practically constant throughout. The phosphoric acid in the feces suffered but little variation, being almost the same in the fore and preservative periods and only 0.109 gram greater in the after period than in the fore period. The phosphoric acid in the urine decreased slightly throughout. The percentage figures show a very slight increase in nonmetabolized phosphoric acid excretion and a more decided decrease (4.71 per cent) in metabolized phosphoric acid. The total elimination decreases 4.06 per cent, and the balance increases 0.115 gram in the preservative period, the increase continuing in the after period. Manifestly in the case of these two subjects there was practically no injurious effect produced by the preservative on phosphoric acid metabolism as a whole.

The summary for Nos. 1, 2, 4, 5, and 6 is complete with the exception of the fourth preservative subperiod. This table shows a slight increase in the quantity of phosphoric acid excreted in the feces during the preservative period, and this increase is almost maintained in the after period, the figures being 0.970 gram, 1.065 grams, and 1.041 grams daily for the three periods. The amounts of phosphoric acid excreted in the urine are 2.325 grams, 2.273 grams, and 2.077 grams daily for the three periods, showing a slight decrease throughout. The average amounts of phosphoric acid ingested remain practically constant. The percentages of phosphoric acid excretion show the same relation, there being 26.56 per cent, 29.65 per cent, and 29.08 per cent, respectively, excreted in the feces during the three periods; 63.66 per cent, 63.27 per cent, and 58.06 per cent, respec-



tively, excreted in the urine. It is seen that the increase in total elimination of phosphoric acid during the preservative period is due exclusively to the increase in the nonmetabolized phosphoric acid excreted. The balances are positive, having values of 0.357 gram, 0.255 gram, and 0.460 gram daily for the three periods respectively, showing a very slight decrease in the preservative period with an increase in the after period, in which the balance exceeds that of the fore period.

A similar summary for those receiving benzoate of soda is shown in the table for Nos. 7 to 12 omitting the fourth preservative subperiod. In this case it is noticed that there is a slight decrease in the amount of phosphoric acid excreted in the feces in the preservative period and a notable increase in the after period, the figures being 1.112 grams, 1.088 grams, and 1.293 grams daily, for the three periods. In the urine there is a progressive decrease in the amount excreted, the daily average being 2.177 grams, 2.145 grams, and 1.957 grams for the three periods respectively. The amounts of phosphoric acid ingested are fairly constant, showing a decrease of less than 0.1 gram daily in the preservative and after periods. The percentages of excretion show such slight variations in the preservative period that no conclusions could be drawn from them, both the metabolized and nonmetabolized phosphoric acid excreted being practically constant. In the after period there is an increased excretion in the feces and a decrease in the urine. The balances average 0.601 gram, 0.569 gram, and 0.473 gram daily for the three periods respectively, showing a slight continuous decrease. These data show practically no effect produced by benzoate of soda in modifying the metabolism of phosphoric acid.

A general summary showing the mass action of the preservative in the two forms upon all of the men, except No. 3, and omitting the fourth preservative subperiod, gives the following results. The average daily amounts of phosphoric acid excreted in the feces are 1.047 grams, 1.077 grams, and 1.178 grams for the three periods. There is, therefore, shown a very slight tendency on the part of the preservative to increase the amount of phosphoric acid excreted in the feces, this increase being due to the effect produced by the preservative administered as benzoic acid. For the urine the averages are as follows: 2.244 grams, 2.203 grams, and 2.012 grams daily for the three periods. There is a slight tendency on the part of benzoic acid in both forms to decrease the quantity of phosphoric acid excreted in the urine. The numbers expressing percentage excretion bear out these inferences, the percentage excreted in the feces increasing throughout, while the percentage excreted in the urine is practically the same in the fore and preservative periods and decidedly less in the after period.



It would, therefore, appear from a study of the phosphoric acid balance sheets that while the effects produced on the metabolism of this substance are not marked, there is a tendency, especially when the preservative is administered as benzoic acid, to increase the quantity and percentage of phosphoric acid excreted in the feces and to a less extent diminish the phosphoric acid excreted in the urine, and this effect is continued in a marked degree in the after period. The administration of these bodies therefore diminishes the excretion of metabolized phosphoric acid and increases the excretion of non-metabolized phosphoric acid, and may be said to interfere in a slight degree with the normal metabolism of phosphoric acid.

TABLE XIII.—*Phosphoric acid balances for Series VIII.*

[Averages are per day.]

No. 1.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Bal- ance (1-4).	9 Ben- zoic acid ad- minis- tered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	13.283	2.285	10.674	12.959	17.20	80.36	97.56	+0.324	0.0
Average.....	2.657	.457	2.135	2.592				+ .065	.0
Second subperiod:									
Total.....	13.601	3.516	11.389	14.905	25.85	83.74	109.59	-1.304	.0
Average.....	2.720	.703	2.278	2.981				- .261	.0
Entire fore period:									
Total.....	26.884	5.801	22.063	27.864	21.58	82.07	103.65	- .980	.0
Average.....	2.688	.580	2.206	2.786				- .098	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	12.770	3.335	10.000	13.355	26.12	78.31	104.42	- .565	5.00
Average.....	2.554	.667	2.000	2.667				- .113	1.00
Second subperiod:									
Total.....	12.695	2.465	9.728	12.193	19.42	76.63	96.05	+ .502	7.50
Average.....	2.539	.493	1.946	2.439				+ .100	1.50
Third subperiod:									
Total.....	13.254	3.642	10.309	13.951	27.48	77.78	105.26	- .697	10.00
Average.....	2.651	.728	2.062	2.790				- .139	2.00
Fourth subperiod:									
Total.....	13.238	2.129	9.382	11.511	16.08	70.87	86.95	+1.727	12.50
Average.....	2.648	.426	1.876	2.302				+ .346	2.50
Entire preservative period:									
Total.....	51.957	11.571	39.419	50.990	22.27	75.87	98.14	+ .967	35.00
Average.....	2.598	.579	1.971	2.550				+ .048	1.75
<i>After period.</i>									
First subperiod:									
Total.....	13.273	3.380	7.897	11.277	25.47	59.50	84.96	+1.996	.0
Average.....	2.655	.676	1.579	2.255				+ .400	.0
Second subperiod:									
Total.....	13.235	4.087	7.882	11.969	30.88	59.55	90.43	+1.296	.0
Average.....	2.647	.817	1.576	2.394				+ .253	.0
Entire after period:									
Total.....	26.508	7.467	15.779	23.246	28.17	59.53	87.69	+3.292	.0
Average.....	2.651	.747	1.578	2.325				+ .226	.0

TABLE XIII.—*Phosphoric acid balances for Series VIII—Continued.*

[Averages are per day.]

No. 2.

Period,	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Bal- ance (1-4).	9 Ben- zoic acid ad- minis- tered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	26.189	5.363	15.664	21.027	20.48	59.81	80.29	+5.162	0.0
Average.....	5.238	1.073	3.133	4.205				+1.033	.0
Second subperiod:									
Total.....	26.095	6.960	17.187	24.147	26.67	65.86	92.53	+1.948	.0
Average.....	5.219	1.392	3.437	4.829				+ .390	.0
Entire fore period:									
Total.....	52.284	12.323	32.851	45.174	23.57	62.83	86.40	+7.110	.0
Average.....	5.228	1.232	3.285	4.517				+ .711	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	25.645	8.330	16.621	24.951	32.48	64.81	97.29	+ .694	5.00
Average.....	5.129	1.666	3.324	4.990				+ .139	1.00
Second subperiod:									
Total.....	25.391	8.354	17.157	25.511	32.90	67.57	100.47	- .120	7.50
Average.....	5.078	1.671	3.431	5.102				- .024	1.50
Third subperiod:									
Total.....	26.700	8.848	16.873	25.721	33.15	63.19	96.33	+ .979	10.00
Average.....	5.340	1.770	3.375	5.144				+ .196	2.00
Fourth subperiod:									
Total.....	25.872	8.514	15.436	23.950	32.91	59.66	92.57	+1.922	2.50
Average.....	5.174	1.703	3.087	4.790				+ .384	.50
Entire preservative period:									
Total.....	103.608	34.046	66.087	100.133	32.86	63.79	96.65	+3.475	25.00
Average.....	5.180	1.702	3.304	5.007				+ .173	1.25
<i>After period.</i>									
First subperiod:									
Total.....	24.419	7.658	15.361	23.019	31.36	62.91	94.27	+1.400	.0
Average.....	4.884	1.532	3.072	4.604				+ .280	.0
Second subperiod:									
Total.....	25.687	7.488	16.268	23.756	29.15	63.33	92.48	+1.931	.0
Average.....	5.137	1.498	3.254	4.751				+ .386	.0
Entire after period:									
Total.....	50.106	15.146	31.629	46.775	30.23	63.12	93.35	+3.331	.0
Average.....	5.011	1.515	3.163	4.678				+ .333	.0

TABLE XIII.—*Phosphoric acid balances for Series VIII—Continued.*

[Averages are per day.]

## No. 3.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Bal- ance (1-4).	9 Ben- zoic acid ad- minis- tered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	24.384	7.319	12.546	19.865	30.02	51.45	81.47	+ 4.519	0.0
Average.....	4.877	1.464	2.509	3.973	.....	.....	.....	+ .904	.0
Second subperiod:									
Total.....	23.696	7.798	12.024	19.822	32.91	50.74	83.65	+ 3.874	.0
Average.....	4.739	1.560	2.405	3.964	.....	.....	.....	+ .775	.0
Entire fore period:									
Total.....	48.080	15.117	24.570	39.687	31.44	51.10	82.54	+ 8.393	.0
Average.....	4.808	1.512	2.457	3.969	.....	.....	.....	+ .839	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	23.577	9.017	12.901	21.918	38.24	54.72	92.96	+ 1.659	5.00
Average.....	4.715	1.803	2.580	4.384	.....	.....	.....	+ .331	1.00
Second subperiod:									
Total.....	24.061	11.473	18.594	30.067	47.68	77.28	124.96	- 6.006	7.50
Average.....	4.812	2.295	3.719	6.013	.....	.....	.....	- 1.201	1.50
Third subperiod:									
Total.....	19.299	4.639	10.751	15.390	24.04	55.71	79.75	+ 3.909	1.00
Average.....	3.860	.928	2.150	3.078	.....	.....	.....	+ .782	.20
Fourth subperiod:									
Total.....	24.583	11.591	10.324	21.915	47.15	42.00	89.15	+ 2.668	.0
Average.....	4.917	2.318	2.065	4.383	.....	.....	.....	+ .534	.0
Entire preservative period:									
Total.....	91.520	36.720	52.570	89.290	40.12	57.44	97.56	+ 2.230	13.50
Average.....	4.576	1.836	2.628	4.464	.....	.....	.....	+ .112	.68
<i>After period.</i>									
First subperiod:									
Total.....	24.440	5.762	11.863	17.625	23.58	48.54	72.12	+ 6.815	.0
Average.....	4.888	1.152	2.373	3.525	.....	.....	.....	+ 1.363	.0
Second subperiod:									
Total.....	24.756	6.900	12.984	19.884	27.87	52.45	80.32	+ 4.872	.0
Average.....	4.951	1.380	2.597	3.977	.....	.....	.....	+ .974	.0
Entire after period:									
Total.....	49.196	12.662	24.847	37.509	25.74	50.51	76.24	+11.687	.0
Average.....	4.920	1.266	2.485	3.751	.....	.....	.....	+ 1.169	.0

TABLE XIII.—*Phosphoric acid balances for Series VIII*—Continued.

[Averages are per day.]

## No. 4.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Balance (1-4).	9 Ben- zoic acid ad- minis- tered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	17.856	5.074	11.609	16.683	28.42	65.01	93.43	+1.173	0.0
Average.....	3.571	1.015	2.322	3.337				+ .234	.0
Second subperiod:									
Total.....	15.903	4.013	10.485	14.498	25.23	65.93	91.17	+1.405	.0
Average.....	3.181	.803	2.097	2.900				+ .281	.0
Entire fore period:									
Total.....	33.759	9.087	22.094	31.181	26.92	65.45	92.36	+2.578	.0
Average.....	3.376	.909	2.209	3.118				+ .258	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	15.732	4.434	10.526	14.960	28.18	66.91	95.09	+ .772	5.00
Average.....	3.146	.887	2.105	2.992				+ .154	1.00
Second subperiod:									
Total.....	15.617	4.181	10.203	14.384	26.77	65.33	92.10	+1.233	7.50
Average.....	3.123	.836	2.041	2.877				+ .246	1.50
Third subperiod:									
Total.....	16.330	4.252	9.682	13.934	26.04	59.29	85.33	+2.396	10.00
Average.....	3.266	.850	1.936	2.787				+ .479	2.00
Fourth subperiod:									
Total.....	16.500*	4.834	9.263	14.097	29.30	56.14	85.44	+2.403	12.50
Average.....	3.300	.967	1.853	2.819				+ .481	2.50
Entire preservative period:									
Total.....	64.179	17.701	39.674	57.375	27.58	61.82	89.40	+6.804	35.00
Average.....	3.209	.885	1.984	2.869				+ .340	1.75
<i>After period.</i>									
First subperiod:									
Total.....	15.691	5.764	10.131	15.895	36.73	64.57	101.30	- .204	.0
Average.....	3.138	1.153	2.026	3.179				- .041	.0
Second subperiod:									
Total.....	16.377	3.827	8.072	11.899	23.37	49.29	72.66	+4.478	.0
Average.....	3.275	.765	1.614	2.380				+ .895	.0
Entire after period:									
Total.....	32.068	9.591	18.203	27.794	29.91	56.76	86.67	+4.274	.0
Average.....	3.207	.959	1.820	2.779				+ .428	.0



TABLE XIII.—*Phosphoric acid balances for Series VIII—Continued.*

[Averages are per day.]

No. 5.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Balance (1-4).	9 Ben- zoic acid ad- minis- tered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	14.546	2.323	<sup>a</sup> 9.251	11.574	15.97	63.60	79.57	2.972	0.0
Average.....	2.909	.465	1.850	2.315	.....	.....	.....	.594	.0
Second subperiod:									
Total.....	14.361	3.917	7.682	11.599	27.28	53.49	80.77	2.762	.0
Average.....	2.872	.783	1.536	2.319	.....	.....	.....	.553	.0
Entire fore period:									
Total.....	28.907	6.240	16.933	23.173	21.59	58.58	80.16	5.734	.0
Average.....	2.891	.624	1.693	2.317	.....	.....	.....	.574	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	14.356	3.763	8.548	12.311	26.21	59.54	85.76	2.045	5.00
Average.....	2.871	.753	1.710	2.463	.....	.....	.....	.408	1.00
Second subperiod:									
Total.....	14.624	3.687	<sup>a</sup> 8.776	12.463	25.21	60.01	85.22	2.161	7.50
Average.....	2.925	.737	1.755	2.492	.....	.....	.....	.433	1.50
Third subperiod:									
Total.....	15.820	3.984	8.757	12.741	25.18	55.35	80.54	3.079	8.00
Average.....	3.164	.797	1.751	2.548	.....	.....	.....	.616	1.60
Fourth subperiod:									
Total.....	14.377	4.508	<sup>a</sup> 7.718	12.226	31.36	53.68	85.04	2.151	3.00
Average.....	2.875	.902	1.544	2.446	.....	.....	.....	.429	.60
Entire preservative period:									
Total.....	59.177	15.942	33.799	49.741	26.94	57.12	84.05	9.436	23.50
Average.....	2.959	.797	1.690	2.487	.....	.....	.....	.472	1.18
<i>After period.</i>									
First subperiod:									
Total.....	14.805	5.044	<sup>a</sup> 8.469	13.513	34.07	57.20	91.27	1.292	.0
Average.....	2.961	1.009	1.694	2.703	.....	.....	.....	.258	.0
Second subperiod:									
Total.....	15.579	2.833	7.709	10.542	18.18	49.48	67.67	5.037	.0
Average.....	3.116	.567	1.542	2.109	.....	.....	.....	1.007	.0
Entire after period:									
Total.....	30.384	7.877	16.178	24.055	25.92	53.25	79.17	6.329	.0
Average.....	3.038	.788	1.618	2.406	.....	.....	.....	.632	.0

<sup>a</sup> Average added to complete period.

TABLE XIII.—*Phosphoric acid balances for Series VIII*—Continued.

[Averages are per day.]

No. 6.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Bal- ance (1-4).	9 Ben- zoic acid ad- minis- tered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	20.678	7.508	11.385	18.893	36.31	55.06	91.37	+1.785	0.0
Average.....	4.136	1.502	2.277	3.779				+ .357	.0
Second subperiod:									
Total.....	20.096	7.535	10.931	18.466	37.50	54.39	91.89	+1.630	.0
Average.....	4.019	1.507	2.186	3.693				+ .326	.0
Entire fore period:									
Total.....	40.774	15.043	22.316	37.359	36.89	54.73	91.62	+3.415	.0
Average.....	4.077	1.504	2.232	3.736				+ .341	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	20.429	7.446	11.174	18.620	36.45	54.70	91.14	+1.809	5.00
Average.....	4.086	1.489	2.235	3.724				+ .362	1.00
Second subperiod:									
Total.....	19.940	5.952	11.475	17.427	29.85	57.55	87.40	+2.513	7.50
Average.....	3.988	1.190	2.295	3.485				+ .503	1.50
Third subperiod:									
Total.....	20.202	7.222	10.675	17.897	35.75	52.84	88.59	+2.305	10.00
Average.....	4.040	1.444	2.135	3.579				+ .461	2.00
Fourth subperiod:									
Total.....	19.922	5.790	11.124	16.914	29.06	55.84	84.90	+3.008	.0
Average.....	3.984	1.158	2.225	3.383				+ .601	.0
Entire preservative period:									
Total.....	80.493	26.410	44.448	70.858	32.81	55.22	88.03	+9.635	22.50
Average.....	4.025	1.320	2.222	3.542				+ .483	1.13
<i>After period.</i>									
First subperiod:									
Total.....	19.442	8.327	11.431	19.758	42.83	58.80	101.63	- .316	.0
Average.....	3.888	1.665	2.286	3.951				- .063	.0
Second subperiod:									
Total.....	20.380	3.620	10.634	14.254	17.76	52.18	69.94	+6.126	.0
Average.....	4.076	.724	2.327	2.851				+1.225	.0
Entire after period:									
Total.....	39.822	11.947	22.065	34.012	30.00	55.41	85.41	+5.810	.0
Average.....	3.982	1.195	2.206	3.401				+ .581	.0

a Daily average added to complete record.

TABLE XIII.—*Phosphoric acid balances for Series VIII—Continued.*

[Averages are per day.]

No. 7.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Balance (1-4).	9 Sodium benzoate administered (calculated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	15.507	5.339	9.854	15.193	34.43	63.55	97.98	+0.314	0.0
Average.....	3.101	1.068	1.971	3.039				+ .062	.0
Second subperiod:									
Total.....	14.796	5.252	9.239	14.491	35.50	62.44	97.94	+ .305	.0
Average.....	2.959	1.050	1.848	2.898				+ .061	.0
Entire fore period:									
Total.....	30.303	10.591	19.093	29.684	34.95	63.01	97.96	+ .619	.0
Average.....	3.030	1.059	1.909	2.968				+ .062	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	14.246	4.471	8.902	13.373	31.38	62.40	93.87	+ .873	4.90
Average.....	2.849	.894	1.780	2.674				+ .175	.98
Second subperiod:									
Total.....	14.374	5.803	8.377	14.180	40.37	58.28	98.65	+ .194	7.50
Average.....	2.875	1.161	1.675	2.836				+ .039	1.50
Third subperiod:									
Total.....	15.009	3.710	7.685	11.395	24.72	51.20	75.92	+3.614	10.00
Average.....	3.002	.742	1.537	2.279				+ .723	2.00
Fourth subperiod:									
Total.....	13.890	3.636	7.939	11.575	26.18	57.16	83.33	+2.315	6.50
Average.....	2.778	.727	1.588	2.315				+ .463	1.30
Entire preservative period:									
Total.....	57.519	17.620	32.903	50.523	30.63	57.20	87.84	+6.996	28.90
Average.....	2.876	.881	1.645	2.526				+ .350	1.45
<i>After period.</i>									
First subperiod:									
Total.....	13.820	5.036	7.398	12.434	36.44	53.53	89.97	+1.386	.0
Average.....	2.764	1.007	1.480	2.487				+ .277	.0
Second subperiod:									
Total.....	13.259	6.063	7.193	13.256	45.73	54.25	99.98	+ .003	.0
Average.....	2.652	1.213	1.439	2.652				+ .000	.0
Entire after period:									
Total.....	27.079	11.099	14.591	25.690	40.99	53.88	94.87	+1.389	.0
Average.....	2.708	1.110	1.459	2.569				+ .139	.0

TABLE XIII.—*Phosphoric acid balances for Series VIII—Continued.*

[Averages are per day.]

No. 8.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4+1).	8 Balance (1-4).	9 Sodium benzoate administered (calculated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	15.884	6.767	9.160	15.927	42.60	57.67	100.27	-0.043	0.0
Average.....	3.177	1.353	1.832	3.185	.....	.....	.....	-.008	.0
Second subperiod:									
Total.....	15.577	2.568	9.458	12.026	16.49	60.72	77.20	+3.551	.0
Average.....	3.115	.514	1.892	2.406	.....	.....	.....	+.709	.0
Entire fore period:									
Total.....	31.461	9.335	18.618	27.953	29.67	59.18	88.85	+3.508	.0
Average.....	3.146	.934	1.862	2.796	.....	.....	.....	+.350	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	15.557	5.867	10.152	16.019	37.71	65.26	102.96	-.462	4.90
Average.....	3.111	1.173	2.030	3.203	.....	.....	.....	-.092	.98
Second subperiod:									
Total.....	15.291	5.050	10.480	15.530	33.02	68.54	101.56	-.239	7.50
Average.....	3.058	1.010	2.096	3.106	.....	.....	.....	-.048	1.50
Third subperiod:									
Total.....	15.891	4.820	8.649	13.469	30.33	54.43	84.76	+2.422	10.00
Average.....	3.178	.964	1.730	2.694	.....	.....	.....	+.484	2.00
Fourth subperiod:									
Total.....	15.714	6.031	8.988	15.019	38.38	57.20	95.58	+.695	12.50
Average.....	3.143	1.206	1.798	3.004	.....	.....	.....	+.139	2.50
Entire preservative period:									
Total.....	62.453	21.778	38.269	60.037	34.86	61.28	96.13	+2.416	34.90
Average.....	3.123	1.089	1.913	3.002	.....	.....	.....	+.121	1.75
<i>After period.</i>									
First subperiod:									
Total.....	15.702	5.646	8.694	14.340	35.96	55.37	91.33	+1.362	.0
Average.....	3.140	1.129	1.739	2.868	.....	.....	.....	+.272	.0
Second subperiod:									
Total.....	16.004	6.141	9.560	15.701	38.37	59.74	98.11	+.303	.0
Average.....	3.201	1.228	1.912	3.140	.....	.....	.....	+.061	.0
Entire after period:									
Total.....	31.706	11.787	18.254	30.041	37.18	57.57	94.75	+1.665	.0
Average.....	3.171	1.179	1.825	3.004	.....	.....	.....	+.167	.0

a Daily average added to complete period.



TABLE XIII.—*Phosphoric acid balances for Series VIII—Continued.*

[Averages are per day.]

No. 9.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Balance (1-4).	9 Sodium benzo- ate ad- minis- tered (calcu- lated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	20.692	6.925	<sup>a</sup> 13.154	20.079	33.47	63.57	97.04	+ 0.613	0.0
Average.....	4.138	1.385	2.631	4.016				+ .122	.0
Second subperiod:									
Total.....	20.568	6.394	11.246	17.640	31.09	54.68	85.76	+ 2.928	.0
Average.....	4.114	1.279	2.249	3.528				+ .586	.0
Entire fore period:									
Total.....	41.260	13.319	24.400	37.719	32.28	59.14	91.42	+ 3.541	.0
Average.....	4.126	1.332	2.440	3.772				+ .354	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	19.991	4.024	<sup>a</sup> 11.772	15.796	20.13	58.89	79.02	+ 4.195	4.90
Average.....	3.998	.805	2.354	3.159				+ .839	.98
Second subperiod:									
Total.....	19.776	6.993	10.589	17.582	35.36	53.54	88.91	+ 2.194	7.50
Average.....	3.955	1.399	2.118	3.517				+ .438	1.50
Third subperiod:									
Total.....	20.428	3.068	11.336	14.404	15.02	55.49	70.51	+ 6.024	10.00
Average.....	4.086	.614	2.267	2.881				+ 1.205	2.00
First, second, and third sub- periods:									
Total.....	60.195	14.085	33.697	47.782	23.40	55.98	79.38	+12.413	22.40
Average.....	4.013	.939	2.247	3.186				+ .827	<sup>b</sup> 1.12
<i>After period.</i>									
First subperiod:									
Total.....	20.050	6.591	10.589	17.180	32.87	52.81	85.69	+ 2.870	.0
Average.....	4.010	1.318	2.118	3.436				+ .574	.0
Second subperiod:									
Total.....	20.340	10.235	10.919	21.154	50.32	53.68	104.00	- .814	.0
Average.....	4.068	2.047	2.184	4.231				- .163	.0
Entire after period:									
Total.....	40.390	16.826	21.508	38.334	41.66	53.25	94.91	+ 2.056	.0
Average.....	4.039	1.683	2.151	3.834				+ .205	.0

<sup>a</sup> Daily average added to complete record.

<sup>b</sup> Average for 20 days.

TABLE XIII.—*Phosphoric acid balances for Series VIII—Continued.*

[Averages are per day.]

No. 10.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Balance (1-4).	9 Sodium benzoate administered (calculated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	18.332	4.552	10.562	15.114	24.83	57.62	82.45	+ 3.218	0.0
Average.....	3.666	.910	2.112	3.022	.....	.....	.....	+ .644	.0
Second subperiod:									
Total.....	18.319	2.439	9.774	12.213	13.31	53.35	66.67	+ 6.106	.0
Average.....	3.664	.488	1.955	2.443	.....	.....	.....	+ 1.221	.0
Entire fore period:									
Total.....	36.651	6.991	20.336	27.327	19.07	55.49	74.56	+ 9.324	.0
Average.....	3.665	.699	2.034	2.733	.....	.....	.....	+ .932	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	18.135	2.081	11.172	13.253	11.48	61.60	73.08	+ 4.882	4.90
Average.....	3.627	.416	2.234	2.650	.....	.....	.....	+ .977	.98
Second subperiod:									
Total.....	17.865	6.231	<sup>a</sup> 10.564	16.795	34.88	59.13	94.01	+ 1.070	7.50
Average.....	3.573	1.246	2.113	3.359	.....	.....	.....	+ .214	1.50
Third subperiod:									
Total.....	16.906	3.470	8.298	11.768	20.53	49.08	69.61	+ 5.138	8.00
Average.....	3.381	.694	1.660	2.354	.....	.....	.....	+ 1.027	1.60
Fourth subperiod:									
Total.....	15.608	2.519	<sup>a</sup> 8.429	10.948	16.14	54.00	70.14	+ 4.660	.0
Average.....	3.122	.504	1.686	2.190	.....	.....	.....	+ .932	.0
Entire preservative period:									
Total.....	68.514	14.301	38.463	52.764	20.87	56.14	77.01	+15.750	20.40
Average.....	3.426	.715	1.923	2.638	.....	.....	.....	+ .788	1.02
<i>After period.</i>									
First subperiod:									
Total.....	18.250	5.995	9.900	15.895	32.85	54.25	87.10	+ 2.355	.0
Average.....	3.650	1.199	1.980	3.179	.....	.....	.....	+ .471	.0
Second subperiod:									
Total.....	17.074	4.164	9.294	13.458	24.39	54.43	78.82	+ 3.616	.0
Average.....	3.415	.833	1.859	2.692	.....	.....	.....	+ .723	.0
Entire after period:									
Total.....	35.324	10.159	19.194	29.353	28.76	54.34	83.10	+ 5.971	.0
Average.....	3.532	1.016	1.919	2.935	.....	.....	.....	+ .597	.0

<sup>a</sup> Daily average added to complete record.

TABLE XIII.—*Phosphoric acid balances for Series VIII—Continued.*

[Averages are per day.]

## No. 11.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Balance (1-4).	9 Sodium benzoate administered calculated as benzoic acid).
<i>Fore period.</i>									
First subperiod:									
Total.....	Grams. 23.290	Grams. 4.832	Grams. 13.543	Grams. 18.375	Per ct. 20.75	Per ct. 58.15	Per ct. 78.90	Grams. 4.915	Grams. 0.0
Average.....	4.658	.966	2.709	3.675				.983	.0
Second subperiod:									
Total.....	23.232	6.174	10.929	17.103	26.58	47.04	73.62	6.129	.0
Average.....	4.646	1.235	2.186	3.421				1.225	.0
Entire fore period:									
Total.....	46.522	11.006	24.472	35.478	23.66	52.60	76.26	11.044	.0
Average.....	4.652	1.101	2.447	3.548				1.104	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	23.254	9.700	13.208	22.908	41.71	56.80	98.51	.346	4.90
Average.....	4.651	1.940	2.642	4.582				.069	.98
Second subperiod:									
Total.....	21.491	7.355	11.030	18.385	34.22	51.32	85.55	3.106	7.50
Average.....	4.298	1.471	2.206	3.677				.621	1.50
Third subperiod:									
Total.....	23.891	5.152	13.250	18.402	21.56	55.46	77.02	5.489	10.00
Average.....	4.778	1.030	2.650	3.680				1.098	2.00
Fourth subperiod:									
Total.....	22.436	7.513	12.904	20.417	33.47	57.51	90.99	2.019	2.50
Average.....	4.487	1.503	2.581	4.084				.403	.50
Entire preservative period:									
Total.....	91.072	29.720	50.392	80.112	32.63	55.33	87.97	10.960	24.90
Average.....	4.554	1.486	2.520	4.006				.548	1.25
<i>After period.</i>									
First subperiod:									
Total.....	23.444	7.779	11.004	18.783	33.18	46.94	80.12	4.601	.0
Average.....	4.689	1.556	2.201	3.757				.932	.0
Second subperiod:									
Total.....	23.244	7.150	11.366	18.516	30.76	48.90	79.66	4.728	.0
Average.....	4.649	1.430	2.273	3.703				.946	.0
Entire after period:									
Total.....	46.688	14.929	22.370	37.299	31.98	47.91	79.89	9.389	.0
Average.....	4.669	1.493	2.237	3.730				.939	.0

TABLE XIII.—*Phosphoric acid balances for Series VIII*—Continued.

[Averages are per day.]

No. 12.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Balance (1-4).	9 Sodium benzo- ate ad- minis- tered (calcu- lated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	22.952	9.152	11.596	20.748	39.87	50.52	90.39	2.204	0.0
Average.....	4.590	1.830	2.319	4.149				.441	.0
Second subperiod:									
Total.....	24.253	6.345	12.080	18.425	26.16	49.81	75.97	5.828	.0
Average.....	4.851	1.269	2.416	3.685				1.166	.0
Entire fore period:									
Total.....	47.205	15.497	23.676	39.173	32.83	50.16	82.98	8.032	.0
Average.....	4.720	1.550	2.368	3.917				.803	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	23.936	7.325	13.306	20.631	30.60	55.59	86.19	3.305	4.90
Average.....	4.787	1.465	2.661	4.126				.661	.98
Second subperiod:									
Total.....	23.596	6.286	12.737	19.023	26.64	53.98	80.62	4.573	7.50
Average.....	4.719	1.257	2.547	3.804				.915	1.50
Third subperiod:									
Total.....	22.508	6.482	11.526	18.008	28.79	51.21	80.01	4.500	10.00
Average.....	4.502	1.296	2.305	3.602				.900	2.00
Fourth subperiod:									
Total.....	19.804	6.786	11.266	18.052	34.27	56.89	91.15	1.752	.0
Average.....	3.961	1.357	2.253	3.610				.351	.0
Entire preservative period:									
Total.....	89.844	26.879	48.835	75.714	29.92	54.36	84.27	14.130	22.40
Average.....	4.492	1.344	2.442	3.786				.706	1.12
<i>After period.</i>									
First subperiod:									
Total.....	20.858	6.377	10.765	17.142	30.57	51.61	82.18	3.716	.0
Average.....	4.172	1.275	2.153	3.428				.744	.0
Second subperiod:									
Total.....	21.374	6.424	10.747	17.171	30.06	50.28	80.34	4.203	.0
Average.....	4.275	1.285	2.149	3.434				.841	.0
Entire after period:									
Total.....	42.232	12.801	21.512	34.313	30.31	50.94	81.25	7.919	.0
Average.....	4.223	1.280	2.151	3.431				.792	.0



TABLE XIII.—*Phosphoric acid balances for Series VIII—Continued.*

## SUMMARIES.

[Averages are per man per day.]

Nos. 1 and 4.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Bal- ance (1-4).	9 Ben- zoic acid admin- istered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	31.139	7.359	22.283	29.642	23.63	71.56	95.19	1.497	0.0
Average.....	3.114	.736	2.228	2.964	.....	.....	.....	.150	.0
Second subperiod:									
Total.....	29.504	7.529	21.874	29.403	25.52	74.14	99.66	.101	.0
Average.....	2.950	.753	2.187	2.940	.....	.....	.....	.010	.0
Entire fore period:									
Total.....	60.643	14.888	44.157	59.045	24.55	72.81	97.36	1.598	.0
Average.....	3.032	.744	2.208	2.952	.....	.....	.....	.080	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	28.502	7.769	20.526	28.295	27.26	72.01	99.27	.207	10.00
Average.....	2.850	.777	2.053	2.830	.....	.....	.....	.020	1.00
Second subperiod:									
Total.....	28.312	6.646	19.931	26.577	23.47	70.40	93.87	1.735	15.00
Average.....	2.831	.665	1.993	2.658	.....	.....	.....	.173	1.50
Third subperiod:									
Total.....	29.584	7.894	19.991	27.885	26.68	67.57	94.25	1.699	20.00
Average.....	2.958	.789	1.999	2.788	.....	.....	.....	.170	2.00
Fourth subperiod:									
Total.....	29.738	6.963	18.645	25.008	23.41	62.70	86.10	4.130	25.00
Average.....	2.974	.696	1.865	2.561	.....	.....	.....	.413	2.50
Entire preservative period:									
Total.....	116.136	29.272	79.093	108.365	25.20	68.10	93.30	7.771	70.00
Average.....	2.904	.732	1.977	2.709	.....	.....	.....	.195	1.75
<i>After period.</i>									
First subperiod:									
Total.....	28.964	9.144	18.028	27.172	31.57	62.24	93.81	1.792	.0
Average.....	2.896	.914	1.803	2.717	.....	.....	.....	.179	.0
Second subperiod:									
Total.....	29.612	7.914	15.954	23.868	26.72	53.88	80.60	5.744	.0
Average.....	2.961	.791	1.595	2.386	.....	.....	.....	.575	.0
Entire after period:									
Total.....	58.576	17.058	33.982	51.040	29.12	58.01	87.13	7.536	.0
Average.....	2.929	.853	1.699	2.552	.....	.....	.....	.377	.0

TABLE XIII.—*Phosphoric acid balances for Series VIII*—Continued.

## SUMMARIES—Continued.

[Averages are per man per day.]

Nos. 1, 2, 4, 5, and 6.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Bal- ance (1-4).	9 Ben- zoic acid admin- istered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	92.552	22.553	58.583	81.136	24.37	63.30	87.66	11.416	0.0
Average.....	3.702	.902	2.343	3.245				.457	.0
Second subperiod:									
Total.....	90.056	25.941	57.674	83.615	28.81	64.04	92.86	6.441	.0
Average.....	3.602	1.038	2.307	3.345				.257	.0
Entire fore period:									
Total.....	182.608	48.494	116.257	164.751	26.56	63.66	90.22	17.857	.0
Average.....	3.652	.970	2.325	3.295				.357	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	88.932	27.308	56.869	84.177	30.71	63.95	94.65	4.755	25.00
Average.....	3.557	1.092	2.275	3.367				.190	1.00
Second subperiod:									
Total.....	88.267	24.639	57.339	81.978	27.91	64.96	92.88	6.289	37.50
Average.....	3.531	.986	2.294	3.279				.252	1.50
Third subperiod:									
Total.....	92.306	27.948	56.296	84.244	30.28	60.99	91.27	8.062	48.00
Average.....	3.692	1.118	2.252	3.370				.322	1.92
First, second, and third sub- periods:									
Total.....	269.505	79.895	170.574	250.399	29.65	63.27	92.91	19.106	110.50
Average.....	3.593	1.065	2.273	3.338				.255	1.47
<i>After period.</i>									
First subperiod:									
Total.....	87.630	30.173	53.289	83.462	34.43	60.81	95.24	4.168	.0
Average.....	3.505	1.207	2.132	3.339				.166	.0
Second subperiod:									
Total.....	91.258	21.855	50.565	72.420	23.95	55.41	79.36	18.838	.0
Average.....	3.650	.874	2.023	2.897				.753	.0
Entire after period:									
Total.....	178.888	52.028	103.854	155.882	29.08	58.06	87.14	23.006	.0
Average.....	3.578	1.041	2.077	3.118				.460	.0

TABLE XIII.—*Phosphoric acid balances for Series VIII—Continued.*

## SUMMARIES—Continued.

[Averages are per man per day.]

Nos. 7 to 12.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Balance (1-4).	9 Sodium benzo- ate ad- minis- tered (calcu- lated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	116.657	37.567	67.869	105.436	32.20	58.18	90.38	11.221	0.0
Average.....	3.889	1.252	2.262	3.514				.375	.0
Second subperiod:									
Total.....	116.745	29.172	62.726	91.898	24.99	53.73	78.72	24.847	.0
Average.....	3.892	.972	2.091	3.063				.829	.0
Entire fore period:									
Total.....	233.402	66.739	130.595	197.334	28.59	55.95	84.54	36.068	.0
Average.....	3.890	1.112	2.177	3.289				.601	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	115.119	33.468	68.512	101.980	29.07	59.51	88.58	13.139	29.40
Average.....	3.837	1.116	2.284	3.399				.438	.98
Second subperiod:									
Total.....	112.393	37.718	63.777	101.495	33.56	56.74	90.30	10.898	45.00
Average.....	3.746	1.257	2.126	3.383				.363	1.50
Third subperiod:									
Total.....	114.633	26.702	60.744	87.446	23.29	52.90	76.28	27.187	58.00
Average.....	3.821	.860	2.025	2.915				.506	1.93
First, second and third sub- periods:									
Total.....	342.145	97.888	193.033	290.921	28.61	56.42	85.03	51.224	132.40
Average.....	3.802	1.088	2.145	3.233				.569	1.47
<i>After period.</i>									
First subperiod.									
Total.....	112.124	37.424	58.350	95.774	33.38	52.04	85.42	16.350	.0
Average.....	3.737	1.247	1.945	3.192				.545	.0
Second subperiod									
Total.....	111.295	40.177	59.079	99.256	36.10	53.08	89.18	12.039	.0
Average.....	3.710	1.339	1.969	3.308				.402	.0
Entire after period.									
Total.....	223.419	77.601	117.429	195.030	34.73	52.56	87.29	28.389	.0
Average.....	3.724	1.293	1.957	3.251				.473	.0

TABLE XIII.—*Phosphoric acid balances for Series VIII—Continued.*

## SUMMARIES—Continued.

[Averages are per man per day.]

Nos. 1 to 12, omitting No. 3.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Bal- ance (1-4).	9 Pre- serva- tive calcu- lated as benzoic acid.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	209.209	60.120	126.452	186.572	28.74	60.44	89.18	22.637	0.0
Average.....	3.804	1.093	2.299	3.392				.412	.0
Second subperiod:									
Total.....	206.801	55.113	120.400	175.513	26.65	58.22	84.87	31.288	.0
Average.....	3.760	1.002	2.189	3.191				.569	.0
Entire fore period:									
Total.....	416.010	115.233	246.852	362.085	27.70	59.34	87.04	53.925	.0
Average.....	3.782	1.047	2.244	3.291				.491	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	204.051	60.776	125.581	186.157	29.78	61.45	91.23	17.894	54.40
Average.....	3.710	1.105	2.280	3.585				.325	.99
Second subperiod:									
Total.....	200.660	62.357	121.116	183.473	31.08	60.36	91.43	17.187	82.50
Average.....	3.648	1.134	2.202	3.356				.312	1.50
Third subperiod:									
Total.....	206.959	54.650	117.040	171.690	26.41	56.56	82.97	35.249	106.00
Average.....	3.763	.994	2.128	3.122				.641	1.93
First, second and third sub- periods:									
Total.....	611.650	177.783	363.537	541.320	29.07	59.44	88.50	70.550	242.90
Average.....	3.707	1.077	2.203	3.281				.426	1.47
<i>After period.</i>									
First subperiod:									
Total.....	199.754	67.597	111.639	179.236	33.84	55.89	89.73	20.518	.0
Average.....	3.632	1.229	2.030	3.259				.373	.0
Second subperiod:									
Total.....	202.553	62.032	109.644	171.676	30.63	54.13	84.76	30.877	.0
Average.....	3.683	1.128	1.994	3.122				.561	.0
Entire after period:									
Total.....	402.307	129.629	221.283	350.912	32.23	55.00	87.22	51.395	.0
Average.....	3.657	1.178	2.012	3.190				.467	.0

## SULPHUR BALANCE.

## INDIVIDUAL DATA.

## No. 1.

The data for No. 1 show a gradual increase in the sulphur excreted in the feces from the fore to the after period. There is a slight increase in the amount of sulphur in the urine in the preservative period, but a marked decrease in the after period. The sulphur ingested remained practically constant. There is a slight increase in the percentage of sulphur excreted in the feces in the preservative period, and a notable increase in the after period. The percentage of sulphur excreted in the urine is notably greater in the preservative



than in the fore period, while it is much less in the after period than in the fore period. The sulphur balance is positive in all cases and its magnitude is the same in the fore and after periods (0.092 gram), while in the preservative period it is but little more than one-third that amount. There seems to be in this case a tendency on the part of the benzoic acid to increase the excretion of sulphur, the total elimination increasing 4.87 per cent, practically all of which is due to the increase in excretion of metabolized sulphur.

*No. 2.*

The data for No. 2 show an increase in the quantity of sulphur in the feces in the preservative period, although the amount in the food is not quite so great as in the fore period. The increase over the fore period is continued but to a less extent in the after period, although the amount of sulphur ingested decreases 0.123 gram daily. There is also a slight increase in the amount of sulphur in the urine in the preservative period but a decrease in the after period. The percentage of sulphur excreted in the feces is notably larger in the preservative and after periods than in the fore period, and the same is true of the percentage excreted in the urine. The balances are positive and have the following magnitudes: 0.205, 0.070, and 0.026 gram daily for the three periods. In the case of No. 2, there is a tendency manifested to increase the amount of sulphur excreted both in the feces and in the urine, the increase in total elimination amounting to 8.94 per cent, with a continued increase of 2.97 in the after period.

*No. 3.*

The data for No. 3 show an increase in the quantity of sulphur excreted in the feces in the preservative period and a decrease in the after period. The amount of sulphur excreted in the urine in the preservative period is practically unchanged, the very slight decrease being somewhat more marked in the after period. The balances are all positive and of the following magnitudes: 0.192 gram, 0.083 gram, and 0.262 gram daily for the three periods. The decrease in the balance is accompanied by a decrease in the amount of sulphur ingested in the preservative period of 0.1 gram, and the percentage figures show a slight increase (1.8) of sulphur in the feces and an increase in the urine of 6.19 per cent. In the after period there is a strong tendency to decrease the percentage excretion of both metabolized and nonmetabolized sulphur, the figures being even smaller than in the fore period, although the amount of sulphur ingested is increased, returning to practically the same figures as in the fore period.

*No. 4.*

In the case of No. 4 the quantity of sulphur in the feces remains practically constant, a negligible decrease being recorded. There is

also a very slight decrease in the amount excreted in the urine. The balances are positive but of small magnitude, being 0.087 gram, 0.089 gram, and 0.028 gram daily for the three periods. The only tendency shown is to diminish very slightly the quantity of sulphur excreted both in the feces and in the urine, the increased excretion in the after period being more marked, as shown by the decrease in the balance, while the figures for the fore and preservative periods show but slight variation.

*No. 5.*

The data for No. 5 show a slight increase in the sulphur in the feces in the preservative period and the same figure is obtained for the after period. There is an increase of the sulphur in the urine during the preservative period, while during the after period it is practically the same as in the fore period. The balances are again positive and their values are 0.153 gram, 0.080 gram, and 0.126 gram daily. The amount of sulphur ingested shows but little variation, increasing very slightly in the preservative period. The slightly increased excretion both in the feces and urine amounts to 2.24 and 7.14 per cent, respectively, with a tendency to return to the conditions of the fore period in the after period for the metabolized sulphur, although the nonmetabolized sulphur excreted continues to increase slightly.

*No. 6.*

The data for No. 6 show a diminution in the sulphur excreted in the feces both in the preservative and after periods and a like diminution occurs in the urine. This decrease tends to increase the magnitude of the positive balance both in the preservative and after periods, the values for the balances being 0.091 gram, 0.101 gram, and 0.131 gram daily for the three periods respectively. In the after period the balance is again slightly increased, owing to a considerable decrease in the percentage of sulphur excreted in the feces and a slight decrease in the metabolized sulphur. The amounts of sulphur ingested decrease very slightly throughout, and while the percentage amount of sulphur excreted in the feces shows a decrease of 1.73 per cent the figure for the urine is practically unchanged.

*No. 7.*

The data for No. 7 show practically no change in the sulphur excreted in the feces during the fore and preservative periods and quite a marked increase during the after period. There is a slight progressive diminution of the amount of sulphur excreted in the urine for the three periods. The balances are all positive, amounting to 0.097 gram, 0.141 gram, and 0.058 gram daily for the three periods. The ingestion is practically constant, there being a very slight decrease throughout. The percentage data show the same relations, the decrease of

4.21 per cent in total elimination being due almost entirely to the decrease in excretion of metabolized sulphur. In the after period the balance is decreased below that of the fore period, due largely to the increase in nonmetabolized sulphur. There appears to be no influence in this case on the part of the preservative to increase the excretion of sulphur in the feces until the after period, but there is a tendency, on the other hand, to diminish very slightly the excretion of the sulphur in the urine, though a partial recovery takes place in the after period.

*No. 8.*

In the case of No. 8 there is an increase in the amount of sulphur excreted in the feces, both in the preservative and after periods. There is also a slight increase in the amount of sulphur excreted in the urine in the preservative period, while in the after period the figure is the same as in the fore period. The percentage data show the same relations in the preservative period, but in the after period the percentages of sulphur in the urine and of total excretion slightly increase. The balances are positive and the daily averages are 0.116 gram, 0.040 gram, and 0.009 gram for the three periods. In this case there appears to be a tendency on the part of the preservative to increase the excretion of sulphur in the feces and also in the urine.

*No. 9.*

The data for No. 9 show a marked decrease in the excretion of sulphur in the feces in the preservative period, but this decrease is more than restored in the after period. There is a slight increase in the excretion of sulphur in the urine both in the preservative and after periods. The balances are positive and amount to 0.147 gram, 0.155 gram, and 0.053 gram daily for the three periods, respectively. The percentages bear out these data and there seems to be a tendency on the part of the preservative to diminish the excretion of sulphur in the feces and to increase slightly its excretion in the urine, resulting in a small increase of the balance in the preservative period.

*No. 10.*

The data for No. 10 show a slight increase in the excretion of sulphur in the feces, both in the preservative and after periods. The quantity excreted in the urine is practically the same throughout, diminishing very slightly in the after period. The balances are positive and rather large, amounting to 0.325 gram, 0.192 gram, and 0.205 gram daily for the three periods. There is a decrease of 0.125 gram daily in the sulphur ingested in the preservative period and practically the same amount is recorded in the after period as in the preservative period. In this case there is a tendency, shown more



clearly by the percentage figures, to increase the excretion of sulphur, especially in the feces, which effect is continued in the after period.

*No. 11.*

In the case of No. 11 there is an increase in the quantity of sulphur excreted in the feces in the preservative period and practically no further change in the after period. The sulphur excreted in the urine is also increased slightly in the preservative period and shows but a slight decrease in the after period. The balances are positive and rather large, namely, 0.292 gram, 0.151 gram, and 0.148 gram daily for the three periods respectively. The amounts of sulphur ingested are practically constant and the percentage data show the same relations as those for actual amounts, namely, rather a marked tendency on the part of the preservative to increase the percentage of sulphur both in the feces and in the urine in the preservative period.

*No. 12.*

The data for No. 12 show an increase in the quantity of sulphur excreted in the feces in the preservative period and a slight decrease in the after period. There is also an increase in the quantity of sulphur excreted in the urine in the preservative period, but a decrease in the after period to a figure below that of the fore period. The balances are positive and quite large, namely, 0.348 gram, 0.184 gram, and 0.169 gram daily for the three periods respectively. The sulphur ingested decreases slightly throughout but the decrease in the balance to almost one-half its original magnitude is due largely to the increase of 9.47 per cent in the metabolized sulphur excreted, the increase in the sulphur in the feces being only 1.35 per cent. In the after period there is very little change from the conditions of the preservative period.

SUMMARIES.

The summary for Nos. 1 and 4 is of interest chiefly as representing the effect of the benzoic acid upon the two men who were able to take the full amount of preservative and complete the fourth preservative subperiod. As would be expected from the previous balances no marked effects on the metabolism of sulphur were produced in this case. The average daily amounts of sulphur ingested are practically constant, with a tendency to decrease; the amount appearing in the feces is virtually unchanged throughout, with a slight tendency to increase; the amounts of sulphur in the urine show a very slight decrease throughout, but the percentage data show a slight increase in the preservative period for both feces and urine which is continued in the case of the feces in the after period, while the metabolized sulphur slightly decreases. The balance shows a very slight decrease throughout.



The summaries which are of the most interest are those for the five men (Nos. 1, 2, 4, 5, and 6) who received benzoic acid, for the six men (Nos. 7 to 12, inclusive) who received sodium benzoate, and for eleven men, omitting No. 3.

The summary for Nos. 1, 2, 4, 5, and 6 indicates that the administration of benzoic acid very slightly increases the excretion of sulphur in the feces during the preservative period, while a very slight increase in the quantity of sulphur excreted in the urine is also shown. In each case the quantity excreted in the after period is less than that excreted in the fore period. It is seen also in the feces and urine combined that there is a slight increase in the amount of sulphur excreted in the preservative period and a decrease in the after period. The average amounts ingested are quite uniform in the three periods with a very slight tendency to decrease. The percentage figures show that 9.76 per cent of sulphur appears in the feces in the fore period, 10.58 per cent in the preservative period, and 10.42 per cent in the after period, while in the urine it is noticed that a similar percentage of increase takes place, rising from 79.16 per cent in the fore period to 82.19 per cent in the preservative period and decreasing to 81.80 per cent in the after period. In both cases there is a smaller quantity of sulphur excreted in the after period than in the fore period, but owing to the slight decrease in the quantity of food the percentage of excretion is larger. The balances are positive and of the following values: 0.126 gram, 0.080 gram, and 0.080 gram daily for the three periods. These data show a slight tendency on the part of the preservative to increase the excretion of sulphur in the feces and urine, thus decreasing the balance, while in the after period the conditions of the preservative period are maintained.

Nos. 7 to 12, inclusive, received benzoate of soda. The data in this case also show a tendency on the part of the benzoate of soda to increase the total quantity of sulphur in the feces both in the preservative and after periods. There is also a similar increase in the urine in the preservative period though the total amount excreted in the after period is slightly less than in the fore period. The amount of sulphur ingested is almost the same in the fore and preservative periods and slightly less in the after period. A comparison made by using the percentage figures is here of value. It is seen that in the feces the percentage excretion rises from 8.62 per cent in the fore period to 9.23 per cent in the preservative period and 11.75 per cent in the after period. In the case of the urine the increase is from 73.21 per cent in the fore period to 76.78 per cent in the preservative period and 78.50 per cent in the after period. The balances are positive and of the following magnitudes: 0.221 gram, 0.167 gram and 0.107 gram daily, for the three periods, showing a uniform

decrease throughout. This summary shows a distinct effect on the part of the benzoate of soda to increase the excretion of sulphur both in the feces and in the urine. The concurrence of the two summaries indicates a decided disturbance of the sulphur metabolism.

The combined effect of the benzoic acid and benzoate of soda is shown in the summary for the eleven men, omitting the fourth preservative subperiod. The increase in the quantity of sulphur excreted in the feces both in the preservative and after periods amounts to only 0.006 and 0.011 gram, respectively, as compared with the fore period. There is also a very slight increase in the quantity of sulphur excreted in the urine in the preservative period (0.020 gram), while the actual quantity excreted in the after period is less than in the fore period. The average daily quantity in the food decreases slightly throughout, and the percentage figures are more marked inasmuch as the actual amounts excreted increase. In the case of the feces the percentage of excretion rises from 9.12 in the fore period to 9.82 in the preservative period and to 11.16 in the after period. The percentage excreted in the urine rises from 75.81 in the fore period to 79.15 in the preservative period and 79.95 in the after period. The balances are positive and of the following magnitudes: 0.177 gram, 0.127 gram, and 0.095 gram daily for the three periods. These data show in another form the tendency on the part of the benzoic acid and benzoate of soda to increase the excretion of sulphur both in the feces and in the urine, and to the extent indicated the metabolism of sulphur may be said to be harmfully affected by the preservative.

TABLE XIV.—*Sulphur balances for Series VIII.*

[Averages are per day.]

No. 1.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Bal- ance (1-4).	9 Benzoic acid admin- istered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	5.626	0.253	4.431	4.684	4.50	78.76	83.26	+0.942	0.0
Average.....	1.125	.051	.886	.937				+ .188	.0
Second subperiod:									
Total.....	5.278	.428	4.867	5.295	8.11	92.21	100.32	- .017	.0
Average.....	1.056	.086	.973	1.059				- .003	.0
Entire fore period:									
Total.....	10.904	.681	9.298	9.979	6.25	85.27	91.52	+ .925	.0
Average.....	1.090	.068	.930	.998				+ .092	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	5.486	.433	4.730	5.163	7.89	86.22	94.11	+ .323	5.00
Average.....	1.097	.087	.946	1.033				+ .064	1.00
Second subperiod:									
Total.....	5.189	.305	4.735	5.040	5.88	91.25	97.13	+ .149	7.50
Average.....	1.038	.061	.947	1.008				+ .030	1.50
Third subperiod:									
Total.....	5.213	.438	4.767	5.205	8.40	91.44	99.85	+ .008	10.00
Average.....	1.043	.088	.953	1.041				+ .002	2.00
Fourth subperiod:									
Total.....	5.250	.288	4.678	4.966	5.49	89.10	94.59	+ .284	12.50
Average.....	1.050	.058	.936	.993				+ .057	2.50
Entire preservative period:									
Total.....	21.138	1.464	18.910	20.374	6.93	89.46	96.39	+ .764	35.00
Average.....	1.057	.073	.946	1.019				+ .038	1.75
<i>After period.</i>									
First subperiod:									
Total.....	5.102	.457	4.311	4.768	8.96	84.50	93.45	+ .334	.0
Average.....	1.020	.091	.862	.954				+ .066	.0
Second subperiod:									
Total.....	4.963	.401	3.973	4.374	8.08	80.05	88.13	+ .589	.0
Average.....	.993	.080	.795	.875				+ .118	.0
Entire after period:									
Total.....	10.065	.858	8.284	9.142	8.52	82.31	90.83	+ .923	0
Average.....	1.006	.086	.828	.914				+ .092	.0

TABLE XIV.—*Sulphur balances for Series VIII—Continued.*

[Averages are per day.]

No. 2.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Bal- ance (1-4).	9 Benzoic acid admin- istered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	7.559	0.615	5.248	5.863	8.14	69.43	77.56	1.696	0.0
Average.....	1.512	.123	1.050	1.173	.....	.....	.....	.339	.0
Second subperiod:									
Total.....	7.167	.726	6.086	6.812	10.13	84.92	95.05	.355	.0
Average.....	1.433	.145	1.217	1.362	.....	.....	.....	.071	.0
Entire fore period:									
Total.....	14.726	1.341	11.334	12.675	9.11	76.97	86.08	2.051	.0
Average.....	1.473	.134	1.133	1.268	.....	.....	.....	.205	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	7.396	.701	5.987	6.688	9.48	80.95	90.43	.708	5.00
Average.....	1.479	.140	1.197	1.338	.....	.....	.....	.141	1.00
Second subperiod:									
Total.....	7.029	.855	5.968	6.823	12.16	84.91	97.07	.206	7.50
Average.....	1.406	.171	1.194	1.365	.....	.....	.....	.041	1.50
Third subperiod:									
Total.....	7.219	.922	5.950	6.872	12.77	82.42	95.19	.347	10.00
Average.....	1.444	.184	1.190	1.374	.....	.....	.....	.070	2.00
Fourth subperiod:									
Total.....	6.676	.791	5.736	6.527	11.85	85.92	97.77	.149	2.50
Average.....	1.335	.158	1.147	1.305	.....	.....	.....	.030	.50
Entire preservative period:									
Total.....	28.320	3.269	23.641	26.910	11.54	83.48	95.02	1.410	25.00
Average.....	1.416	.163	1.182	1.346	.....	.....	.....	.070	1.25
<i>After period.</i>									
First subperiod:									
Total.....	6.416	.814	5.545	6.359	12.69	86.42	99.11	.057	.0
Average.....	1.283	.163	1.109	1.272	.....	.....	.....	.011	.0
Second subperiod:									
Total.....	6.512	.693	5.616	6.309	10.64	86.24	96.88	.203	.0
Average.....	1.302	.139	1.123	1.262	.....	.....	.....	.040	.0
Entire after period:									
Total.....	12.928	1.507	11.161	12.668	11.66	86.33	97.99	.260	.0
Average.....	1.293	.151	1.116	1.267	.....	.....	.....	.026	.0



TABLE XIV.—*Sulphur balances for Series VIII—Continued.*

[Averages are per day.]

No. 3.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Bal- ance (1-4).	9 Benzoic acid admin- istered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	6.704	0.475	5.027	5.502	7.09	74.99	82.07	+1.202	0.0
Average.....	1.341	.095	1.005	1.100				+ .241	.0
Second subperiod:									
Total.....	6.138	.430	4.986	5.416	7.01	81.23	88.24	+ .722	.0
Average.....	1.228	.086	.997	1.083				+ .145	.0
Entire fore period:									
Total.....	12.842	.905	10.013	10.918	7.05	77.97	85.02	+1.924	.0
Average.....	1.284	.090	1.001	1.092				+ .192	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	6.586	.579	5.224	5.803	8.79	79.32	88.11	+ .783	5.00
Average.....	1.317	.116	1.045	1.161				+ .156	1.00
Second subperiod:									
Total.....	6.376	.626	5.124	5.750	9.82	80.36	90.18	+ .626	7.50
Average.....	1.275	.125	1.025	1.150				+ .125	1.50
Third subperiod:									
Total.....	4.492	.269	4.939	5.208	5.99	109.95	115.94	- .716	1.00
Average.....	.898	.054	.988	1.042				- .144	.20
Fourth subperiod:									
Total.....	6.185	.618	4.607	5.225	9.99	74.49	84.48	+ .960	.0
Average.....	1.237	.124	.921	1.045				+ .192	.0
Entire preservative period:									
Total.....	23.639	2.092	19.894	21.986	8.85	84.16	93.01	+1.658	13.50
Average.....	1.182	.105	.995	1.099				+ .083	.68
<i>After period.</i>									
First subperiod:									
Total.....	6.248	.376	4.602	4.978	6.02	73.66	79.67	+1.270	.0
Average.....	1.250	.075	.920	.996				+ .254	.0
Second subperiod:									
Total.....	6.137	.345	4.437	4.782	5.62	72.30	77.92	+1.355	.0
Average.....	1.227	.069	.887	.956				+ .271	.0
Entire after period:									
Total.....	12.385	.721	9.039	9.760	5.82	72.98	78.81	+2.625	.0
Average.....	1.238	.072	.904	.976				+ .262	.0

TABLE XIV.—*Sulphur balances for Series VIII—Continued.*

[Averages are per day.]

## No. 4.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Bal- ance (1-4).	9 Benzoic acid admin- istered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	5.801	0.482	4.391	4.873	8.31	75.69	84.00	+0.928	0.0
Average.....	1.160	.096	.878	.975				+ .185	.0
Second subperiod:									
Total.....	5.289	.428	4.914	5.342	8.09	92.91	101.00	— .053	.0
Average.....	1.058	.086	.983	1.068				— .010	.0
Entire fore period:									
Total.....	11.090	.910	9.305	10.215	8.21	83.90	92.11	+ .875	.0
Average.....	1.109	.091	.930	1.022				+ .087	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	5.477	.441	4.663	5.104	8.05	85.14	93.19	+ .373	5.00
Average.....	1.095	.088	.933	1.021				+ .074	1.00
Second subperiod:									
Total.....	5.147	.425	4.278	4.703	8.26	83.12	91.37	+ .444	7.50
Average.....	1.029	.085	.856	.941				+ .088	1.50
Third subperiod:									
Total.....	5.204	.418	4.204	4.622	8.03	80.78	88.82	+ .582	10.00
Average.....	1.041	.084	.841	.924				+ .117	2.00
Fourth subperiod:									
Total.....	5.180	.469	4.335	4.804	9.05	83.69	92.74	+ .376	12.50
Average.....	1.036	.094	.867	.961				+ .075	2.50
Entire preservative period:									
Total.....	21.008	1.753	17.480	19.233	8.34	83.21	91.55	+1.775	35.00
Average.....	1.050	.087	.874	.961				+ .089	1.75
<i>After period.</i>									
First subperiod:									
Total.....	5.033	.481	4.695	5.176	9.56	93.28	102.84	— .143	.0
Average.....	1.007	.096	.939	1.035				— .028	.0
Second subperiod:									
Total.....	4.974	.374	4.180	4.554	7.52	84.04	91.56	+ .420	.0
Average.....	.995	.075	.836	.911				+ .084	.0
Entire after period:									
Total.....	10.007	.855	8.875	9.730	8.54	88.69	97.22	+ .277	.0
Average.....	1.001	.086	.876	.973				+ .028	0

TABLE XIV.—Sulphur balances for Series VIII—Continued.

[Averages are per day.]

No. 5.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Bal- ance (1-4).	9 Benzoic acid admin- istered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	4.200	0.281	<sup>a</sup> 2.915	3.196	6.60	68.43	75.02	1.064	0.0
Average.....	.852	.056	.583	.639	.....	.....	.....	.213	.0
Second subperiod:									
Total.....	3.772	.478	2.820	3.298	12.67	74.76	87.43	.474	.0
Average.....	.754	.096	.564	.660	.....	.....	.....	.094	.0
Entire fore period:									
Total.....	8.032	.759	5.735	6.494	9.45	71.40	80.85	1.538	.0
Average.....	.803	.076	.574	.650	.....	.....	.....	.153	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	4.237	.535	3.078	3.613	12.63	72.65	85.27	.624	5.00
Average.....	.847	.107	.616	.723	.....	.....	.....	.124	1.00
Second subperiod:									
Total.....	4.142	.466	<sup>a</sup> 3.421	3.887	11.25	82.59	93.84	.255	7.50
Average.....	.828	.093	.684	.777	.....	.....	.....	.051	1.50
Third subperiod:									
Total.....	4.252	.462	3.431	3.893	10.87	80.69	91.56	.359	8.00
Average.....	.850	.092	.686	.779	.....	.....	.....	.071	1.60
Fourth subperiod:									
Total.....	3.916	.471	<sup>a</sup> 3.066	3.537	12.03	78.29	90.32	.379	3.00
Average.....	.783	.094	.613	.707	.....	.....	.....	.076	.60
Entire preservative period:									
Total.....	16.547	1.934	12.996	14.930	11.69	78.54	90.23	1.617	23.50
Average.....	.827	.097	.650	.747	.....	.....	.....	.080	1.18
<i>After period.</i>									
First subperiod:									
Total.....	3.982	.588	<sup>a</sup> 2.954	3.542	14.77	74.18	88.95	.440	.0
Average.....	.796	.118	.591	.708	.....	.....	.....	.088	.0
Second subperiod:									
Total.....	3.947	.383	2.802	3.185	9.58	70.10	79.68	.812	.0
Average.....	.790	.076	.560	.637	.....	.....	.....	.162	.0
Entire after period:									
Total.....	7.979	.971	5.756	6.727	12.17	72.14	84.31	1.252	.0
Average.....	.798	.097	.576	.673	.....	.....	.....	.126	.0

<sup>a</sup> Daily average added to complete record.

TABLE XIV.—*Sulphur balances for Series VIII—Continued.*

[Averages are per day.]

No. 6.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4+1).	8 Bal- ance (1-4).	9 Benzoic acid admin- istered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	6.244	0.905	4.670	5.575	14.49	74.79	89.29	0.669	0.0
Average.....	1.249	.181	.934	1.115	.....	.....	.....	.134	.0
Second subperiod:									
Total.....	5.841	.952	4.650	5.602	16.30	79.61	95.91	.239	.0
Average.....	1.168	.190	.930	1.120	.....	.....	.....	.048	.0
Entire fore period:									
Total.....	12.085	1.857	9.320	11.177	15.37	77.12	92.49	.908	.0
Average.....	1.208	.186	.932	1.118	.....	.....	.....	.091	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	6.191	.887	4.374	5.261	14.33	70.65	84.98	.930	5.00
Average.....	1.238	.177	.875	1.052	.....	.....	.....	.186	1.00
Second subperiod:									
Total.....	5.736	.745	4.530	5.275	12.99	78.97	91.96	.461	7.50
Average.....	1.147	.149	.906	1.055	.....	.....	.....	.092	1.50
Third subperiod:									
Total.....	5.579	.805	4.509	5.314	14.43	80.82	95.25	.265	10.00
Average.....	1.116	.161	.902	1.063	.....	.....	.....	.053	2.00
Fourth subperiod:									
Total.....	5.324	.678	4.289	4.967	12.73	80.56	93.29	.357	.0
Average.....	1.065	.136	.858	.993	.....	.....	.....	.072	.0
Entire preservative period:									
Total.....	22.830	3.115	17.702	20.817	13.64	77.54	91.18	2.013	22.50
Average.....	1.142	.156	.885	1.041	.....	.....	.....	.101	1.13
<i>After period.</i>									
First subperiod:									
Total.....	5.278	.839	4.118	4.957	15.90	78.02	93.92	.321	.0
Average.....	1.056	.168	.824	.991	.....	.....	.....	.065	.0
Second subperiod:									
Total.....	a 5.435	a .355	a 4.689	4.444	6.53	75.23	81.77	.991	.0
Average.....	1.087	.071	.818	.889	.....	.....	.....	.198	.0
Entire after period:									
Total.....	10.713	1.194	8.207	9.401	11.15	76.61	87.75	1.312	.0
Average.....	1.071	.119	.821	.940	.....	.....	.....	.131	.0

a Daily average added to complete record.



TABLE XIV.—*Sulphur balances for Series VIII—Continued.*

[Averages are per day.]

No. 7.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Bal- ance (1-4).	9 Sodium benzo- ate ad- minis- tered (calcu- lated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	5.715	0.529	4.423	4.952	9.26	77.39	86.65	+ 0.763	0.0
Average.....	1.143	.106	.885	.990				+ .153	.0
Second subperiod:									
Total.....	5.332	.548	4.576	5.124	10.28	85.82	96.10	+ .208	.0
Average.....	1.066	.110	.915	1.025				+ .041	.0
Entire fore period:									
Total.....	11.047	1.077	8.999	10.076	9.75	81.46	91.21	+ .971	.0
Average.....	1.105	.108	.900	1.008				+ .097	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	5.598	.543	4.564	5.107	9.70	81.53	91.23	+ .491	4.90
Average.....	1.120	.109	.913	1.021				+ .099	.98
Second subperiod:									
Total.....	5.345	.637	3.987	4.624	11.92	74.59	86.51	+ .721	7.50
Average.....	1.069	.127	.797	.925				+ .144	1.50
Third subperiod:									
Total.....	5.836	.435	3.796	4.231	7.45	65.04	72.50	+ 1.605	10.00
Average.....	1.167	.087	.759	.846				+ .321	2.00
Fourth subperiod:									
Total.....	4.958	.486	4.464	4.950	9.80	90.04	99.84	+ .008	6.50
Average.....	.992	.097	.893	.990				+ .002	1.30
Entire preservative period:									
Total.....	21.737	2.101	16.811	18.912	9.67	77.34	87.00	+ 2.825	28.90
Average.....	1.087	.105	.841	.946				+ .141	1.45
<i>After period.</i>									
First subperiod:									
Total.....	4.826	.577	3.603	4.180	11.96	74.66	86.61	+ .646	.0
Average.....	.965	.115	.721	.836				+ .129	.0
Second subperiod:									
Total.....	4.676	.747	3.996	4.743	15.98	85.46	101.43	— .067	.0
Average.....	.935	.149	.799	.949				— .014	.0
Entire after period:									
Total.....	9.502	1.324	7.599	8.923	13.93	79.97	93.91	+ .579	.0
Average.....	.950	.132	.760	.892				+ .058	.0

TABLE XIV.—*Sulphur balances for Series VIII—Continued.*

[Averages are per day.]

## No. 8.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Bal- ance (1-4).	9 Sodium benzo- ate admin- istered (calcu- lated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	5.387	0.818	4.133	4.951	15.18	76.72	91.91	+0.436	0.0
Average.....	1.077	.164	.827	.990				+ .087	.0
Second subperiod:									
Total.....	5.185	.324	4.132	4.456	6.25	79.69	85.94	+ .729	.0
Average.....	1.037	.065	.826	.891				+ .146	.0
Entire fore period:									
Total.....	10.572	1.142	8.265	9.407	10.80	78.18	88.98	+1.165	.0
Average.....	1.057	.114	.826	.941				+ .116	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	5.378	.810	4.373	5.183	15.06	81.31	96.37	+ .195	4.90
Average.....	1.076	.162	.875	1.037				+ .039	.98
Second subperiod:									
Total.....	5.034	.690	<sup>a</sup> 4.252	4.942	13.71	84.47	98.17	+ .092	7.50
Average.....	1.007	.138	.850	.988				+ .019	1.50
Third subperiod:									
Total.....	5.089	.681	4.113	4.794	13.38	80.82	94.20	+ .295	10.00
Average.....	1.018	.136	.822	.959				+ .059	2.00
Fourth subperiod:									
Total.....	5.036	.773	4.047	4.820	15.35	80.36	95.71	+ .216	12.50
Average.....	1.007	.155	.809	.964				+ .043	2.50
Entire preservative period:									
Total.....	20.537	2.954	16.785	19.739	14.38	81.73	96.11	+ .798	34.90
Average.....	1.027	.148	.839	.987				+ .040	1.75
<i>After period.</i>									
First subperiod:									
Total.....	4.988	.756	4.074	4.830	15.16	81.68	96.83	+ .158	.0
Average.....	.998	.151	.815	.966				+ .032	.0
Second subperiod:									
Total.....	4.891	.781	4.182	4.963	15.97	85.50	101.47	— .072	.0
Average.....	.978	.156	.836	.993				— .015	.0
Entire after period:									
Total.....	9.879	1.537	8.256	9.793	15.56	83.57	99.13	+ .086	.0
Average.....	.988	.154	.826	.979				+ .009	.0

<sup>a</sup> Daily average added to complete record.

TABLE XIV.—*Sulphur balances for Series VIII—Continued.*

[Averages are per day.]

## No. 9.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Balance (1-4).	9 Sodium benzoate administered (calculated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	6.168	0.514	<sup>a</sup> 4.832	5.346	8.33	78.34	86.67	0.822	0.0
Average.....	1.234	.103	.966	1.069	.....	.....	.....	.165	.0
Second subperiod:									
Total.....	5.956	.550	4.753	5.303	9.23	79.80	89.04	.653	.0
Average.....	1.191	.110	.951	1.061	.....	.....	.....	.130	.0
Entire fore period:									
Total.....	12.124	1.064	9.585	10.649	8.78	79.06	87.83	1.475	.0
Average.....	1.212	.106	.958	1.065	.....	.....	.....	.147	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	6.074	.259	<sup>a</sup> 4.800	5.119	4.26	80.01	84.28	.955	4.90
Average.....	1.215	.052	.972	1.024	.....	.....	.....	.191	.98
Second subperiod:									
Total.....	5.928	.504	4.464	4.968	8.50	75.30	83.81	.960	7.50
Average.....	1.186	.101	.893	.994	.....	.....	.....	.192	1.50
Third subperiod:									
Total.....	5.861	.232	5.219	5.451	3.96	89.05	93.00	.410	10.00
Average.....	1.172	.046	1.044	1.090	.....	.....	.....	.082	2.00
First, second, and third subperiods:									
Total.....	17.863	.995	14.543	15.538	5.57	81.41	86.98	2.325	22.40
Average.....	1.191	.066	.970	1.036	.....	.....	.....	.155	<sup>b</sup> 1.12
<i>After period.</i>									
First subperiod:									
Total.....	5.763	.503	4.919	5.422	8.73	85.35	94.08	.341	.0
Average.....	1.153	.101	.984	1.084	.....	.....	.....	.069	.0
Second subperiod:									
Total.....	5.697	.696	4.810	5.506	12.22	84.43	96.65	.191	.0
Average.....	1.139	.139	.962	1.101	.....	.....	.....	.038	.0
Entire after period:									
Total.....	11.460	1.199	9.729	10.928	10.46	84.90	95.36	.532	.0
Average.....	1.146	.120	.973	1.093	.....	.....	.....	.053	.0

<sup>a</sup> Daily average added to complete record.<sup>b</sup> Average for 20 days.

TABLE XIV.—*Sulphur balances for Series VIII—Continued.*

[Averages are per day.]

No. 10.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Bal- ance (1-4).	9 Sodium benzo- ate ad- minis- tered (calcu- lated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	6.024	0.611	3.861	4.472	10.14	64.09	74.24	1.552	0.0
Average.....	1.205	.122	.772	.894				.311	.0
Second subperiod:									
Total.....	5.898	.353	3.842	4.195	5.99	65.14	71.13	1.703	.0
Average.....	1.180	.071	.768	.839				.341	.0
Entire fore period:									
Total.....	11.922	.964	7.703	8.667	8.09	64.61	72.70	3.255	.0
Average.....	1.192	.096	.770	.867				.325	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	6.095	.312	4.394	4.706	5.12	72.09	77.21	1.389	4.90
Average.....	1.219	.062	.479	.941				.278	.98
Second subperiod:									
Total.....	5.753	.899	<sup>a</sup> 4.236	5.135	15.63	73.63	89.26	.618	7.50
Average.....	1.151	.180	.847	1.027				.124	1.50
Third subperiod:									
Total.....	5.134	.459	3.555	4.014	8.94	69.24	78.18	1.120	8.00
Average.....	1.027	.092	.711	.803				.224	1.60
Fourth subperiod:									
Total.....	4.359	.393	<sup>a</sup> 3.244	3.637	9.02	74.42	83.44	.722	.0
Average.....	.872	.079	.649	.727				.145	.0
Entire preservative period:									
Total.....	21.341	2.063	15.429	17.492	9.67	72.30	81.96	3.849	20.40
Average.....	1.067	.103	.771	.875				.192	1.02
<i>After period.</i>									
First subperiod:									
Total.....	5.717	.619	3.674	4.293	10.83	64.26	75.09	1.424	.0
Average.....	1.143	.124	.735	.859				.284	.0
Second subperiod:									
Total.....	4.911	.636	3.654	4.290	12.95	74.40	87.35	.621	.0
Average.....	.982	.127	.731	.858				.124	.0
Entire after period:									
Total.....	10.628	1.255	7.328	8.583	11.81	68.95	80.76	2.045	.0
Average.....	1.063	.126	.733	.858				.205	.0

<sup>a</sup> Daily average added to complete record.



TABLE XIV.—*Sulphur balances for Series VIII—Continued.*

[Averages are per day.]

No. 11.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Bal- ance (1-4).	9 Sodium benzo- ate admin- istered (calcu- lated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total .....	6.907	0.445	5.188	5.633	6.44	75.11	81.55	1.274	0.0
Average .....	1.381	.089	1.038	1.127	.....	.....	.....	.254	.0
Second subperiod:									
Total .....	6.692	.479	4.569	5.048	7.16	68.28	75.43	1.644	.0
Average .....	1.338	.096	.914	1.010	.....	.....	.....	.328	.0
Entire fore period:									
Total .....	13.599	.924	9.757	10.681	6.79	71.75	78.54	2.918	.0
Average .....	1.360	.092	.976	1.068	.....	.....	.....	.292	.0
<i>Preservative period.</i>									
First subperiod:									
Total .....	6.985	.731	5.356	6.087	10.47	76.68	87.14	.898	4.90
Average .....	1.397	.146	1.071	1.217	.....	.....	.....	.180	.98
Second subperiod:									
Total .....	6.433	.670	4.655	5.325	10.42	72.36	82.78	1.108	7.50
Average .....	1.287	.134	.931	1.065	.....	.....	.....	.222	1.50
Third subperiod:									
Total .....	6.731	.432	5.437	5.869	6.42	80.78	87.19	.862	10.00
Average .....	1.346	.086	1.087	1.174	.....	.....	.....	.172	2.00
Fourth subperiod:									
Total .....	5.994	.596	5.241	5.837	9.94	87.44	97.38	.157	2.50
Average .....	1.199	.119	1.048	1.167	.....	.....	.....	.032	.50
Entire preservative period:									
Total .....	26.143	2.429	20.689	23.118	9.29	79.14	88.43	3.025	24.90
Average .....	1.307	.121	1.034	1.156	.....	.....	.....	.151	1.25
<i>After period.</i>									
First subperiod:									
Total .....	6.583	.648	5.027	5.675	9.84	76.36	86.21	.908	.0
Average .....	1.317	.130	1.005	1.135	.....	.....	.....	.182	.0
Second subperiod:									
Total .....	6.363	.574	5.223	5.797	9.02	82.08	91.10	.566	.0
Average .....	1.273	.115	1.045	1.160	.....	.....	.....	.113	.0
Entire after period:									
Total .....	12.946	1.222	10.250	11.472	9.44	79.18	88.61	1.474	.0
Average .....	1.295	.122	1.025	1.147	.....	.....	.....	.148	.0

TABLE XIV.—*Sulphur balances for Series VIII—Continued.*

[Averages are per day.]

No. 12.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Bal- ance (1-4).	9 Sodium benzo- ate ad- minis- tered (calcu- lated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams</i>	<i>Grams</i>	<i>Grams.</i>	<i>Per ct</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	6.901	0.577	4.507	5.084	8.36	65.31	73.67	1.817	0.0
Average.....	1.380	.115	.901	1.017	.....	.....	.....	.363	.0
Second subperiod:									
Total.....	6.807	.545	4.605	5.150	8.01	67.65	75.66	1.657	.0
Average.....	1.361	.109	.921	1.030	.....	.....	.....	.331	.0
Entire fore period:									
Total.....	13.708	1.122	9.112	10.234	8.19	66.47	74.66	3.474	.0
Average.....	1.371	.112	.911	1.023	.....	.....	.....	.348	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	7.002	.583	5.277	5.860	8.33	75.36	83.69	1.142	4.90
Average.....	1.400	.117	1.055	1.172	.....	.....	.....	.228	.98
Second subperiod:									
Total.....	6.599	.498	4.882	5.380	7.55	73.98	81.53	1.219	7.50
Average.....	1.320	.100	.976	1.076	.....	.....	.....	.244	1.50
Third subperiod:									
Total.....	6.366	.526	4.925	5.451	8.26	77.36	85.62	.915	10.00
Average.....	1.273	.105	.985	1.090	.....	.....	.....	.183	2.00
Fourth subperiod:									
Total.....	5.354	.808	4.146	4.954	15.09	77.44	92.53	.400	.0
Average.....	1.071	.162	.829	9.91	.....	.....	.....	.080	.0
Entire preservative period:									
Total.....	25.321	2.415	19.230	21.645	9.54	75.94	85.48	3.676	22.40
Average.....	1.266	.121	.962	1.082	.....	.....	.....	.184	1.12
<i>After period.</i>									
First subperiod:									
Total.....	5.742	.584	4.195	4.779	10.17	73.66	83.23	.963	.0
Average.....	1.148	.117	.839	.956	.....	.....	.....	.192	.0
Second subperiod:									
Total.....	5.523	.594	4.199	4.793	10.76	76.03	86.78	.730	.0
Average.....	1.105	.119	.834	.959	.....	.....	.....	.146	.0
Entire after period:									
Total.....	11.265	1.178	8.394	9.572	10.46	74.51	84.97	1.693	.0
Average.....	1.126	.118	.839	.957	.....	.....	.....	.169	.0

TABLE XIV.—*Sulphur balances for Series VIII—Continued.*

## SUMMARIES.

[Averages are per man per day.]

Nos. 1 and 4.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Bal- ance (1-4).	9 Benzoic acid admin- istered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	11.427	0.735	8.822	9.557	6.43	77.20	83.64	+1.870	0.0
Average.....	1.143	.074	.882	.956				+ .187	.0
Second subperiod:									
Total.....	10.567	.856	9.781	10.637	8.10	92.56	100.66	— .070	.0
Average.....	1.057	.086	.978	1.064				— .007	.0
Entire fore period:									
Total.....	21.994	1.591	18.603	20.194	7.23	84.58	91.82	+1.800	.0
Average.....	1.100	.079	.930	1.010				+ .090	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	10.963	.874	9.393	10.267	7.97	85.68	93.66	+ .696	10.00
Average.....	1.096	.087	.939	1.020				+ .070	1.00
Second subperiod:									
Total.....	10.336	.730	9.013	9.743	7.06	87.20	94.26	+ .593	15.00
Average.....	1.034	.073	.901	.974				+ .060	1.50
Third subperiod:									
Total.....	10.417	.856	8.971	9.827	8.22	86.12	94.34	+ .590	20.00
Average.....	1.042	.086	.897	.983				+ .059	2.00
Fourth subperiod:									
Total.....	10.430	.757	9.013	9.770	7.26	86.41	93.67	+ .660	25.00
Average.....	1.043	.076	.901	.977				+ .066	2.50
Entire preservative period:									
Total.....	42.146	3.217	36.390	39.607	7.63	86.34	93.98	+2.539	70.00
Average.....	1.054	.080	.910	.990				+ .064	1.75
<i>After period.</i>									
First subperiod:									
Total.....	10.135	.938	9.006	9.944	9.26	88.86	98.12	+ .191	.0
Average.....	1.014	.094	.901	.995				+ .019	.0
Second subperiod:									
Total.....	9.937	.775	8.153	8.928	7.80	82.05	89.85	+1.009	.0
Average.....	.994	.078	.815	.893				+ .101	.0
Entire after period:									
Total.....	20.072	1.713	17.159	18.872	8.53	85.49	94.02	+1.200	.0
Average.....	1.004	.086	.858	.944				+ .060	.0

TABLE XIV.—*Sulphur balances for Series VIII*—Continued.

## SUMMARIES—Continued.

[Averages are per man per day.]

Nos. 1, 2, 4, 5, and 6.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Bal- ance (1-4).	9 Benzoic acid admin- istered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	29.490	2.535	21.655	24.191	8.60	75.43	82.03	5.299	0.0
Average.....	1.180	.101	.866	.968				.212	.0
Second subperiod:									
Total.....	27.347	3.012	23.337	26.349	11.01	86.34	96.35	.998	.0
Average.....	1.094	.120	.934	1.054				.040	.0
Entire fore period:									
Total.....	56.837	5.548	44.992	50.540	9.76	79.16	88.92	6.297	.0
Average.....	1.137	.111	.900	1.011				.126	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	28.787	2.997	22.832	25.829	10.41	79.31	89.72	2.958	25.00
Average.....	1.151	.120	.913	1.033				.118	1.00
Second subperiod:									
Total.....	27.243	2.796	22.932	25.728	10.26	84.18	94.44	1.515	37.50
Average.....	1.090	.112	.917	1.029				.061	1.50
Third subperiod:									
Total.....	27.467	3.045	22.861	25.906	11.09	83.23	94.32	1.561	48.00
Average.....	1.099	.122	.914	1.036				.063	1.92
First, second, and third sub- periods:									
Total.....	83.497	8.838	68.625	77.463	10.58	82.19	92.77	6.034	110.50
Average.....	1.113	.118	.915	1.033				.080	1.47
<i>After period.</i>									
First subperiod:									
Total.....	25.811	3.179	21.623	24.802	12.32	83.77	96.09	1.009	.0
Average.....	1.032	.127	.865	.992				.040	.0
Second subperiod:									
Total.....	25.881	2.206	20.660	22.866	8.52	79.83	88.35	3.015	.0
Average.....	1.035	.088	.826	.914				.121	.0
Entire after period:									
Total.....	51.692	5.385	42.283	47.668	10.42	81.80	92.22	4.024	.0
Average.....	1.034	.108	.846	.954				.080	.0



TABLE XIV.—*Sulphur balances for Series VIII—Continued.*

SUMMARIES—Continued.

[Averages are per man per day.]

Nos. 7 to 12.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Bal- ance (1-4).	9 Sodium benzo- ate ad- minis- tered (calcu- lated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	37.102	3.494	26.944	30.438	9.42	72.62	82.04	6.664	0.0
Average.....	1.237	.116	.898	1.015				.222	.0
Second subperiod:									
Total.....	35.870	2.799	26.477	29.276	7.80	73.81	81.62	6.594	.0
Average.....	1.196	.093	.883	.976				.220	.0
Entire fore period:									
Total.....	72.972	6.293	53.421	59.714	8.62	73.21	81.83	13.258	.0
Average.....	1.216	.105	.890	.995				.221	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	37.132	3.238	28.824	32.062	8.72	77.63	86.35	5.070	29.40
Average.....	1.238	.108	.961	1.069				.169	.98
Second subperiod:									
Total.....	35.092	3.898	26.476	30.374	11.11	75.45	86.56	4.718	45.00
Average.....	1.170	.130	.883	1.012				.158	1.50
Third subperiod:									
Total.....	35.017	2.765	27.045	29.810	7.90	77.23	85.13	5.207	58.00
Average.....	1.167	.092	.902	.994				.173	1.93
First, second, and third subperiods:									
Total.....	107.241	9.901	82.345	92.246	9.23	76.78	86.02	14.995	132.40
Average.....	1.192	.110	.926	1.025				.167	1.47
<i>After period.</i>									
First subperiod:									
Total.....	33.619	3.687	25.492	29.179	10.97	75.82	86.79	4.440	.0
Average.....	1.121	.123	.850	.973				.148	.0
Second subperiod:									
Total.....	32.061	4.028	26.064	30.092	12.56	81.29	93.86	1.969	.0
Average.....	1.069	.134	.869	1.003				.066	.0
Entire after period:									
Total.....	65.680	7.715	51.556	59.271	11.75	78.50	90.24	6.409	.0
Average.....	1.095	.129	.859	.988				.107	.0

TABLE XIV.—*Sulphur balances for Series VIII—Continued.*

## SUMMARIES—Continued.

[Averages are per man per day.]

Nos. 1 to 12, omitting No. 3.

Period.	1	2	3	4	5	6	7	8	9
	In food.	In feces.	In urine.	In feces and urine (2+3).	In feces (2+1).	In urine (3+1).	In feces and urine (4+1).	Balance (1-4).	Preservative calculated as benzoic acid.
<i>Fore period.</i>									
First subperiod:									
Total.....	Grams. 66.592	Grams. 6.030	Grams. 48.599	Grams. 54.629	Per ct. 9.06	Per ct. 72.98	Per ct. 82.04	Grams. 11.903	Grams. 0.0
Average.....	1.211	.110	.884	.994				.217	.0
Second subperiod:									
Total.....	63.217	5.811	49.814	55.625	9.19	78.80	87.99	7.592	.0
Average.....	1.149	.105	.906	1.011				.138	.0
Entire fore period:									
Total.....	129.809	11.841	98.413	110.254	9.12	75.81	84.93	19.555	.0
Average.....	1.180	.108	.895	1.003				.177	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	65.919	6.235	51.656	57.891	9.46	78.36	87.82	8.028	54.40
Average.....	1.199	.113	.939	1.052				.147	.99
Second subperiod:									
Total.....	62.335	6.694	49.408	56.102	10.74	79.26	90.00	6.233	82.50
Average.....	1.133	.122	.898	1.020				.113	1.50
Third subperiod:									
Total.....	62.484	5.810	49.906	55.716	9.20	79.87	89.17	6.768	106.00
Average.....	1.136	.106	.907	1.013				.123	1.93
First, second, and third subperiods:									
Total.....	190.738	18.739	150.970	169.709	9.82	79.15	88.97	21.029	242.90
Average.....	1.156	.114	.915	1.029				.127	1.47
<i>After period.</i>									
First subperiod:									
Total.....	59.430	6.866	47.115	53.981	11.55	79.28	90.83	5.449	.0
Average.....	1.080	.125	.857	.982				.098	.0
Second subperiod:									
Total.....	57.942	6.234	46.724	52.958	10.76	80.64	91.40	4.984	.0
Average.....	1.053	.113	.850	.963				.091	.0
Entire after period:									
Total.....	117.372	13.100	93.839	106.939	11.16	79.95	91.11	10.433	.0
Average.....	1.067	.119	.853	.972				.095	.0

## FAT BALANCE.

## INDIVIDUAL DATA.

## No. 1.

In the case of No. 1 there is little effect produced upon the amount and percentage of fat which is digested and absorbed in the fore and preservative periods. There is an increase of 0.41 gram daily in the undigested fat in the feces in the after period. The decrease in the balance corresponds almost exactly to the decrease in the amount ingested, but the percentage of fat appearing in the feces indicate a slight increased excretion in the preservative and after periods, the daily averages being 2.21, 2.37, and 2.78, respectively. In this case

there seems to be a very slight tendency on the part of the benzoic acid to increase the percentage excretion of the fat, notwithstanding the decrease in the amount ingested.

*No. 2.*

In the case of No. 2 the influence manifested on the part of the preservative in inhibiting the digestion and absorption of the fat is much more marked, the quantity in the feces having increased 1.05 grams in the preservative period despite a decrease in amount ingested of 3.68 grams, and this increase does not entirely disappear in the after period, though the amount ingested again decreases 6.81 grams. Expressed as percentages of the fat ingested, the amounts found in the feces for the three periods are 4.39, 5.45, and 5.27, respectively. The decrease in the balance in the preservative period is about 1 gram greater than the decrease in amount ingested.

*No. 3.*

The data for No. 3 show an increase of fat in the feces during the preservative period and a very great decrease in the after period, while the amount ingested again decreases greatly (16.44 grams) but increases in the after period (7.89 grams). Expressed in percentages of the fat ingested, the quantities in the feces are 3.43, 4.18, and 2.41 per cent, respectively. The variations in the balance correspond to those in ingestion. In this case, there seems to be again a slight tendency on the part of the benzoic acid to inhibit the metabolism of fat.

*No. 4.*

The data for No. 4 show a decreased excretion of the fat in the preservative and after periods as compared with the fore period. The percentages of fat ingested appearing in the feces for the three periods are 3.73, 3.36, and 3.11, respectively. In this case the amounts of fat ingested are much smaller than in the preceding cases; they decrease somewhat throughout, and the absorption of the fat is more complete.

*No. 5.*

In the case of No. 5 there is an increase of the fat in the feces in the preservative period of 0.4 gram and also a slight increase in the after period as compared with the fore period. The percentages of fat ingested appearing in the feces are 3.73, 4.53, and 3.90, respectively. There is again a slight increase in excretion though the amounts ingested are very small, and remarkably constant, decreasing only 1 gram in the preservative period and being practically the same in the after period.

*No. 6.*

In the case of No. 6 there is a very marked decrease in the quantity of fat appearing in the feces in the preservative period, and this decrease becomes greater in the after period. Expressed in percentages the amounts appearing in the feces are 5.98 per cent, 4.09 per cent, and 3.25 per cent, respectively. The decrease in the balance throughout is less than the decrease in ingestion. Here there seems to be a strong tendency on the part of the preservative to increase the metabolism of fat.

*No. 7.*

In the case of No. 7 there is a slight diminution in the quantity of fat appearing in the feces in the preservative period and an increase in the after period. Expressed in percentages of fat ingested there occur in the feces 3.32 per cent, 3.07 per cent, and 4.56 per cent for the three periods respectively. The decrease in the balance throughout again corresponds to the decrease in ingestion. In this instance there again appears to be a slight influence exerted on the part of the preservative to increase the metabolism of fat.

*No. 8.*

The data for No. 8 show a slight increase of fat in the feces in the preservative period and an equal increase occurs in the after period. Expressed as percentages of fat ingested there are found in the feces 2.87 per cent, 3.38 per cent, and 3.85 per cent, respectively, in the three periods. The amounts ingested decrease very slightly in this case, and there is an apparent tendency on the part of the preservative to decrease slightly the assimilation of fat.

*No. 9.*

In the case of No. 9 the quantity of fat in the feces is notably diminished in the preservative period, while in the after period it is increased to a larger quantity than in the fore period. Expressed as percentages of fat ingested there occur in the feces 2.72 per cent, 2.12 per cent, and 3.58 per cent for the three periods respectively. The balances and the amounts ingested decrease throughout. The effect in this case is not marked, but a slightly greater assimilation of the fat under the influence of the preservative is indicated.

*No. 10.*

No. 10 shows a slight increase in the quantity of fat in the feces in the preservative period, and this increase is continued in the after period. Expressed as percentages of fat ingested there occur in the feces 3.23 per cent, 3.84 per cent, and 4.15 per cent in the three periods respectively. In this case a slight inhibition of the fat metabolism is indicated.



*No. 11.*

The data for No. 11 show a notable increase in the quantity of fat found in the feces in the preservative period, while in the after period the amount is not so great. Expressed as percentages of fat ingested there occur in the feces 2.04 per cent, 2.94 per cent, and 2.54 per cent for the three periods respectively. These data show a slight tendency on the part of the preservative to inhibit the digestion and absorption of the fat. The balance decreases in the preservative period and remains unchanged in the after period, which is also true of the amounts ingested.

*No. 12.*

In the case of No. 12 less fat is found in the feces in the preservative period than in the fore period, while in the after period there is an increased quantity, but it is not so great as in the fore period. Expressed in percentages of fat ingested there occur in the feces 3.57 per cent, 3.09 per cent, and 3.68 per cent in the three periods respectively. These data show a tendency on the part of the benzoate of soda to increase the absorption of the fat during the preservative period. The balances and amounts ingested show the usual relative decrease throughout.

## SUMMARIES.

The average action of the benzoic acid and the benzoate of soda are shown in the summary for Nos. 1, 2, 4, 5, and 6, and Nos. 7 to 12, inclusive, including all the observations except those for the fourth preservative period, for which the data are irregular owing to the illness of the subjects. The data for Nos. 1, 2, 4, 5, and 6 show a diminution of the actual quantity of fat in the feces during the preservative period and a still further decrease in the after period. The decrease in the balance is in almost exact proportion to the decrease in amounts ingested as is shown also by the percentage data, which show that 3.99 per cent, 3.90 per cent, and 3.68 per cent of the ingested fat occur in the three periods respectively. These data indicate that the benzoic acid tends to increase very slightly the absorption of fat, but the variation is so small and the variation in the individual data so wide that no positive conclusion can be drawn.

The summary for Nos. 7 to 12, inclusive, shows a slight diminution of the quantity of fat in the feces during the preservative period and a notable increase in the after period, while the amounts ingested decrease throughout, the decrease being greater in the after period. Expressed as percentages of fat ingested, it is seen that there occur in the feces 2.96 per cent, 2.83 per cent, and 3.66 per cent in the three periods respectively. These data again show a slight tendency on

the part of the preservative to increase the digestibility and absorption of fat during the preservative period, while in the after period a marked effect is produced of the opposite character, despite the decrease in ingested fat.

Regarding the data as a whole, including the eleven men, it is noticed that the quantity of fat in the feces falls from 3.48 grams daily in the fore period to 3.26 grams daily in the preservative period, and rises again to 3.46 grams daily in the after period. The amount of fat ingested decreases approximately 3 and 5 grams in the preservative and after periods, respectively. Expressed as percentages of fat ingested it is seen that 3.39 per cent is found in the feces in the fore period, 3.28 per cent in the preservative period, and 3.67 per cent in the after period.

These data show a very slight effect on the part of the benzoic acid and benzoates to increase the digestibility and absorption of the fat but that this effect is followed in the after period by an increase in the fat excreted, the percentage amount being slightly greater than in the fore period. The data, therefore, are not conclusive, and it appears that no notable effect is produced by benzoic acid and benzoate of soda upon the metabolism of fat.

Nos. 1 and 4, who completed the entire observation covering four subperiods, show a slight decrease in both quantity and percentage of fat excreted in the preservative period, with an increase in the after period, and the amounts ingested decreasing throughout. It will be seen that practically the same effect is shown in this case as in the larger summaries, strengthening the conclusion that the preservative produces no demonstrable effect upon the metabolism of fat.

TABLE XV.—*Fat balances for Series VIII.*

[Averages are per day.]

## No. 1.

Period.	1 In food.	2 In feces.	3 In feces (2÷1).	4 Balance (1-2).	5 Benzoic acid admin- istered.
<i>Fore period.</i>					
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Per cent.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	587.39	9.85	1.68	577.54	0.0
Average.....	117.48	1.97	.....	115.51	.0
Second subperiod:					
Total.....	592.25	16.25	2.74	576.00	.0
Average.....	118.45	3.25	.....	115.20	.0
Entire fore period:					
Total.....	1,179.64	26.10	2.21	1,153.54	.0
Average.....	117.96	2.61	.....	115.35	.0
<i>Preservative period.</i>					
First subperiod:					
Total.....	542.86	15.20	2.80	527.66	5.00
Average.....	108.57	3.04	.....	105.53	1.00
Second subperiod:					
Total.....	540.64	10.08	1.86	530.56	7.50
Average.....	108.13	2.02	.....	106.11	1.50
Third subperiod:					
Total.....	525.06	16.06	3.06	509.00	10.00
Average.....	105.01	3.21	.....	101.80	2.00
Fourth subperiod:					
Total.....	523.48	9.28	1.77	514.20	12.50
Average.....	104.70	1.86	.....	102.84	2.50
Entire preservative period:					
Total.....	2,132.04	50.62	2.37	2,081.42	35.00
Average.....	106.60	2.53	.....	104.07	1.75
<i>After period.</i>					
First subperiod:					
Total.....	521.61	14.85	2.85	506.76	.0
Average.....	104.32	2.97	.....	101.35	.0
Second subperiod:					
Total.....	536.97	14.57	2.71	522.40	.0
Average.....	107.39	2.91	.....	104.48	.0
Entire after period:					
Total.....	1,058.58	29.42	2.78	1,029.16	.0
Average.....	105.86	2.94	.....	102.92	.0

TABLE XV.—*Fat balances for Series VIII*—Continued.

[Averages are per day.]

No. 2.

Period.	1 In food.	2 In feces.	3 In feces (2÷1).	4 Balance (1-2).	5 Benzoic acid admin- istered.
<i>Fore period.</i>					
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Per cent.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	592.34	23.52	3.97	568.82	0.0
Average.....	118.47	4.70	.....	113.77	.0
Second subperiod:					
Total.....	579.69	27.89	4.81	551.80	.0
Average.....	115.94	5.58	.....	110.36	.0
Entire fore period:					
Total.....	1,172.03	51.41	4.39	1,120.62	.0
Average.....	117.20	5.14	.....	112.06	.0
<i>Preservative period.</i>					
First subperiod:					
Total.....	602.96	31.97	5.30	570.99	5.00
Average.....	120.59	6.39	.....	114.20	1.00
Second subperiod:					
Total.....	563.90	27.86	4.94	536.04	7.50
Average.....	112.78	5.57	.....	107.21	1.50
Third subperiod:					
Total.....	571.59	30.66	5.35	540.93	10.00
Average.....	114.32	6.13	.....	108.19	2.00
Fourth subperiod:					
Total.....	531.89	33.27	6.26	498.62	2.50
Average.....	106.38	6.65	.....	99.73	.50
Entire preservative period:					
Total.....	2,270.31	123.76	5.45	2,146.58	25.00
Average.....	113.52	6.19	.....	107.33	1.25
<i>After period.</i>					
First subperiod:					
Total.....	533.84	30.14	5.65	503.70	.0
Average.....	106.77	6.03	.....	100.74	.0
Second subperiod:					
Total.....	533.22	26.07	4.89	507.15	.0
Average.....	106.64	5.21	.....	101.43	.0
Entire after period:					
Total.....	1,067.06	56.21	5.27	1,010.85	.0
Average.....	106.71	5.62	.....	101.09	.0



TABLE XV.—*Fat balances for Series VIII*—Continued.

[Averages are per day.]

No. 3.

Period.	1 In food.	2 In feces.	3 In feces (2÷1).	4 Balance (1-2).	5 Benzoic acid admin- istered.
<i>Fore period.</i>					
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Per cent.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	628.48	20.90	3.33	607.58	0.0
Average.....	125.70	4.18		121.52	.0
Second subperiod:					
Total.....	593.58	20.96	3.53	572.62	.0
Average.....	118.72	4.19		114.53	.0
Entire fore period:					
Total.....	1,222.06	41.86	3.43	1,180.20	.0
Average.....	122.21	4.19		118.02	.0
<i>Preservative period.</i>					
First subperiod:					
Total.....	618.56	23.39	3.78	595.17	5.00
Average.....	123.71	4.68		119.03	1.00
Second subperiod:					
Total.....	584.00	25.95	4.44	558.05	7.50
Average.....	116.80	5.19		111.61	1.50
Third subperiod:					
Total.....	371.83	10.06	2.71	361.77	1.00
Average.....	74.37	2.01		72.36	.20
Fourth subperiod:					
Total.....	541.02	29.00	5.36	512.02	.0
Average.....	108.20	5.80		102.40	.0
Entire preservative period:					
Total.....	2,115.41	88.40	4.18	2,027.01	13.50
Average.....	105.77	4.42		101.35	.68
<i>After period.</i>					
First subperiod:					
Total.....	573.85	16.55	2.88	557.30	.0
Average.....	114.77	3.31		111.46	.0
Second subperiod:					
Total.....	562.70	10.84	1.93	551.86	.0
Average.....	112.54	2.17		110.37	.0
Entire after period:					
Total.....	1,136.55	27.39	2.41	1,109.16	.0
Average.....	113.66	2.74		110.92	.0

TABLE XV.—*Fat balances for Series VIII—Continued.*

[Averages are per day.]

## No. 4.

Period.	1 In food.	2 In feces.	3 In feces (2+1).	4 Balance (1-2).	5 Benzoic acid admin- istered.
<i>Fore period.</i>					
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Per cent.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	462.56	18.07	3.91	444.49	0.0
Average.....	92.51	3.61	.....	88.90	.0
Second subperiod:					
Total.....	416.08	14.72	3.54	401.36	.0
Average.....	83.22	2.94	.....	80.28	.0
Entire fore period:					
Total.....	878.64	32.79	3.73	845.85	.0
Average.....	87.86	3.28	.....	84.58	.0
<i>Preservative period.</i>					
First subperiod:					
Total.....	425.21	16.67	3.92	408.54	5.00
Average.....	85.04	3.33	.....	81.71	1.00
Second subperiod:					
Total.....	411.92	12.75	3.10	399.17	7.50
Average.....	82.38	2.55	.....	79.83	1.50
Third subperiod:					
Total.....	404.86	12.46	3.08	392.40	10.00
Average.....	80.97	2.49	.....	78.48	2.00
Fourth subperiod:					
Total.....	408.35	13.54	3.32	394.81	12.50
Average.....	81.67	2.71	.....	78.96	2.50
Entire preservative period:					
Total.....	1,650.34	55.42	3.36	1,594.92	35.00
Average.....	82.52	2.77	.....	79.75	1.75
<i>After period.</i>					
First subperiod:					
Total.....	401.51	13.96	3.48	387.55	.0
Average.....	80.30	2.79	.....	77.51	.0
Second subperiod:					
Total.....	409.73	11.27	2.75	398.46	.0
Average.....	81.95	2.25	.....	79.70	.0
Entire after period:					
Total.....	811.24	25.23	3.11	786.01	.0
Average.....	81.12	2.52	.....	78.60	.0

TABLE XV.—*Fat balances for Series VIII*—Continued.

[Averages are per day.]

## No. 5.

Period.	1 In food.	2 In feces.	3 In feces (2÷1).	4 Balance (1-2).	5 Benzoic acid admin- istered.
<i>Fore period.</i>					
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Per cent.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	273.88	8.33	3.04	265.55	0.0
Average.....	54.78	1.67	.....	53.11	.0
Second subperiod:					
Total.....	280.51	12.34	4.40	268.17	.0
Average.....	56.10	2.47	.....	53.63	.0
Entire fore period:					
Total.....	554.39	20.67	3.73	533.72	.0
Average.....	55.44	2.07	.....	53.37	.0
<i>Preservative period.</i>					
First subperiod:					
Total.....	296.92	12.14	4.09	284.78	5.00
Average.....	59.38	2.43	.....	56.95	1.00
Second subperiod:					
Total.....	267.21	10.73	4.02	256.48	7.50
Average.....	53.44	2.15	.....	51.29	1.50
Third subperiod:					
Total.....	275.24	11.70	4.25	263.54	8.00
Average.....	55.05	2.34	.....	52.71	1.60
Fourth subperiod:					
Total.....	249.29	14.76	5.92	234.53	3.00
Average.....	49.86	2.95	.....	46.91	.60
Entire preservative period:					
Total.....	1,088.66	49.33	4.53	1,039.33	23.50
Average.....	54.43	2.47	.....	51.96	1.18
<i>After period.</i>					
First subperiod:					
Total.....	282.41	12.15	4.30	270.26	.0
Average.....	56.48	2.43	.....	54.05	.0
Second subperiod:					
Total.....	260.14	8.99	3.46	251.15	.0
Average.....	52.03	1.80	.....	50.23	.0
Entire after period:					
Total.....	542.55	21.14	3.90	521.41	.0
Average.....	54.26	2.11	.....	52.15	.0

TABLE XV.—*Fat balances for Series VIII*—Continued.

[Averages are per day.]

## No. 6.

Period.	1 In food.	2 In feces.	3 In feces (2÷1).	4 Balance (1-2).	5 Benzoic acid admin- istered.
<i>Fore period.</i>					
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Per cent.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	515.42	33.49	6.50	481.93	0.0
Average.....	103.08	6.70	.....	96.38	.0
Second subperiod:					
Total.....	490.18	26.64	5.43	463.54	.0
Average.....	98.04	5.33	.....	92.71	.0
Entire fore period:					
Total.....	1,005.60	60.13	5.98	945.47	.0
Average.....	100.56	6.01	.....	94.55	.0
<i>Preservative period.</i>					
First subperiod:					
Total.....	508.54	21.43	4.21	487.11	5.00
Average.....	101.71	4.29	.....	97.42	1.00
Second subperiod:					
Total.....	473.69	15.49	3.27	458.20	7.50
Average.....	94.74	3.10	.....	91.64	1.50
Third subperiod:					
Total.....	454.57	22.69	4.99	431.88	10.00
Average.....	90.91	4.54	.....	86.37	2.00
Fourth subperiod:					
Total.....	443.57	17.31	3.90	426.26	.0
Average.....	88.71	3.46	.....	85.25	.0
Entire preservative period:					
Total.....	1,880.37	76.92	4.09	1,803.45	22.50
Average.....	94.02	3.85	.....	90.17	1.13
<i>After period.</i>					
First subperiod:					
Total.....	452.75	19.97	4.41	432.78	.0
Average.....	90.55	3.99	.....	86.56	.0
Second subperiod:					
Total.....	<sup>a</sup> 467.16	<sup>a</sup> 9.96	2.13	457.20	.0
Average.....	93.43	1.99	.....	91.44	.0
Entire after period:					
Total.....	919.91	29.93	3.25	889.98	.0
Average.....	91.99	2.99	.....	89.00	.0

<sup>a</sup> Daily average added to complete record.



TABLE XV.—*Fat balances for Series VIII—Continued.*

[Averages are per day.]

## No. 7.

Period.	1 In food.	2 In feces.	3 In feces (2+1).	4 Balance (1-2).	5 Sodium benzoate admin- istered (calcu- lated as benzoic acid).
<i>Fore period.</i>					
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Per cent.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	553.03	18.57	3.36	534.46	0.0
Average.....	110.61	3.71	.....	106.90	.0
Second subperiod:					
Total.....	520.46	17.09	3.28	503.37	.0
Average.....	104.09	3.42	.....	100.67	.0
Entire fore period:					
Total.....	1,073.49	35.66	3.32	1,037.83	.0
Average.....	107.35	3.57	.....	103.78	.0
<i>Preservative period.</i>					
First subperiod:					
Total.....	536.21	14.10	2.63	522.11	4.90
Average.....	107.24	2.82	.....	104.42	.98
Second subperiod:					
Total.....	516.88	21.93	4.24	494.95	7.50
Average.....	103.38	4.39	.....	98.99	1.50
Third subperiod:					
Total.....	533.77	14.34	2.69	519.43	10.00
Average.....	106.75	2.87	.....	103.88	2.00
Fourth subperiod:					
Total.....	454.94	12.30	2.70	442.64	6.50
Average.....	90.99	2.46	.....	88.53	1.30
Entire preservative period:					
Total.....	2,041.80	62.67	3.07	1,979.13	28.90
Average.....	102.09	3.14	.....	98.95	1.45
<i>After period.</i>					
First subperiod:					
Total.....	495.51	22.05	4.45	473.46	.0
Average.....	99.10	4.41	.....	94.69	.0
Second subperiod:					
Total.....	418.22	19.59	4.68	498.63	.0
Average.....	83.64	3.92	.....	79.72	.0
Entire after period:					
Total.....	913.73	41.64	4.56	872.09	.0
Average.....	91.37	4.16	.....	87.21	.0

TABLE XV.—*Fat balances for Series VIII—Continued.*

[Averages are per day.]

No. 8.

Period.	1 In food.	2 In feces.	3 In feces (2+1).	4 Balance (1-2).	5 Sodium benzoate admin- istered (calcu- lated as benzoic acid).
<i>Fore period.</i>					
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Per cent.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	365.95	15.51	4.24	350.44	0.0
Average.....	73.19	3.10	.....	70.09	.0
Second subperiod:					
Total.....	344.16	4.88	1.42	339.28	.0
Average.....	68.83	.98	.....	67.85	.0
Entire fore period:					
Total.....	710.11	20.39	2.87	689.72	.0
Average.....	71.01	2.04	.....	68.97	.0
<i>Preservative period.</i>					
First subperiod:					
Total.....	364.21	12.57	3.45	351.64	4.90
Average.....	72.84	2.51	.....	70.33	.98
Second subperiod:					
Total.....	344.18	10.10	2.93	334.08	7.50
Average.....	68.84	2.02	.....	66.82	1.50
Third subperiod:					
Total.....	352.05	10.09	2.87	341.96	10.00
Average.....	70.41	2.02	.....	68.39	2.00
Fourth subperiod:					
Total.....	321.03	13.95	4.35	307.08	12.50
Average.....	64.21	2.79	.....	61.42	2.50
Entire preservative period:					
Total.....	1,381.47	46.71	3.38	1,334.76	34.90
Average.....	69.07	2.34	.....	66.73	1.75
<i>After period.</i>					
First subperiod:					
Total.....	346.64	13.21	3.81	333.43	.0
Average.....	69.33	2.64	.....	66.69	.0
Second subperiod:					
Total.....	340.21	13.22	3.89	326.99	.0
Average.....	68.04	2.64	.....	65.40	.0
Entire after period:					
Total.....	686.85	26.43	3.85	660.42	.0
Average.....	68.68	2.64	.....	66.04	.0

TABLE XV.—*Fat balances for Series VIII*—Continued.

[Averages are per day.]

## No. 9.

Period.	1 In food.	2 In feces.	3 In feces (2+1).	4 Balance (1-2).	5 Sodium benzoate admin- istered (calcu- lated as benzoic acid).
<i>Fore period.</i>					
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Per cent.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	653.67	19.38	2.96	634.29	0.0
Average.....	130.73	3.88	.....	126.85	.0
Second subperiod:					
Total.....	627.40	15.51	2.47	611.89	.0
Average.....	125.48	3.10	.....	122.38	.0
Entire fore period:					
Total.....	1,281.07	34.89	2.72	1,246.18	.0
Average.....	128.11	3.49	.....	124.62	.0
<i>Preservative period.</i>					
First subperiod:					
Total.....	638.87	8.22	1.29	630.65	4.90
Average.....	127.77	1.64	.....	126.13	.98
Second subperiod:					
Total.....	614.49	22.25	3.62	592.24	7.50
Average.....	122.90	4.45	.....	118.45	1.50
Third subperiod:					
Total.....	595.61	8.76	1.47	586.85	10.00
Average.....	119.12	1.75	.....	117.37	2.00
First, second, and third subperiods:					
Total.....	1,848.97	39.23	2.12	1,809.74	22.40
Average.....	123.26	2.62	.....	120.64	a 1.12
<i>After period.</i>					
First subperiod:					
Total.....	586.66	17.62	3.00	569.04	.0
Average.....	117.33	3.52	.....	113.81	.0
Second subperiod:					
Total.....	601.55	24.87	4.13	576.68	.0
Average.....	120.31	4.97	.....	115.34	.0
Entire after period:					
Total.....	1,188.21	42.49	3.58	1,145.72	.0
Average.....	118.82	4.25	.....	114.57	.0

a Average for 20 days.

TABLE XV.—*Fat balances for Series VIII*—Continued.

[Averages are per day.]

No. 10.

Period.	1 In food.	2 In feces.	3 In feces (2+1).	4 Balance (1-2).	5 Sodium benzoate admin- istered (calcu- lated as benzoic acid).
<i>Fore period.</i>					
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Per cent.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	464.52	19.80	4.28	444.72	0.0
Average.....	92.90	3.96	.....	88.94	.0
Second subperiod:					
Total.....	455.21	9.88	2.17	445.33	.0
Average.....	91.04	1.98	.....	89.06	.0
Entire fore period:					
Total.....	919.73	29.68	3.23	890.05	.0
Average.....	91.97	2.97	.....	89.00	.0
<i>Preservative period.</i>					
First subperiod:					
Total.....	474.47	9.06	1.91	465.41	4.90
Average.....	94.89	1.81	.....	93.08	.98
Second subperiod:					
Total.....	447.52	23.71	5.30	423.81	7.50
Average.....	89.50	4.74	.....	84.76	1.50
Third subperiod:					
Total.....	428.41	16.52	3.86	411.89	8.00
Average.....	85.68	3.30	.....	82.39	1.60
Fourth subperiod:					
Total.....	357.12	16.38	4.59	340.74	.0
Average.....	71.42	3.28	.....	68.14	.0
Entire preservative period:					
Total.....	1,707.52	65.67	3.84	1,641.85	20.40
Average.....	85.38	3.28	.....	82.10	1.02
<i>After period.</i>					
First subperiod:					
Total.....	450.41	18.93	4.20	431.48	.0
Average.....	90.08	3.79	.....	86.29	.0
Second subperiod:					
Total.....	409.46	16.77	4.10	392.69	.0
Average.....	81.89	3.35	.....	78.54	.0
Entire after period:					
Total.....	859.87	35.70	4.15	824.17	.0
Average.....	85.99	3.57	.....	82.42	.0



TABLE XV.—*Fat balances for Series VIII—Continued.*

[Averages are per day.]

No. 11.

Period.	1 In food.	2 In feces.	3 In feces (2÷1).	4 Balance (1-2).	5 Sodium benzoate administered (calculated as benzoic acid).
<i>Fore period.</i>					
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Per cent.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	588.00	11.52	1.96	576.48	0.0
Average.....	117.60	2.30	.....	115.30	.0
Second subperiod:					
Total.....	593.49	12.55	2.11	580.94	.0
Average.....	118.70	2.51	.....	116.19	.0
Entire fore period:					
Total.....	1,181.49	24.07	2.04	1,157.42	.0
Average.....	118.15	2.41	.....	115.74	.0
<i>Preservative period.</i>					
First subperiod:					
Total.....	625.32	19.20	3.07	606.12	4.90
Average.....	125.06	3.84	.....	121.22	.98
Second subperiod:					
Total.....	563.09	17.78	3.16	545.31	7.50
Average.....	112.62	3.56	.....	109.06	1.50
Third subperiod:					
Total.....	589.32	12.85	2.18	576.47	10.00
Average.....	117.86	2.57	.....	115.29	2.00
Fourth subperiod:					
Total.....	518.88	17.72	3.42	501.16	2.50
Average.....	103.78	3.54	.....	100.23	.50
Entire preservative period:					
Total.....	2,296.61	67.55	2.94	2,229.06	24.90
Average.....	114.83	3.38	.....	111.45	1.25
<i>After period.</i>					
First subperiod:					
Total.....	581.53	14.55	2.50	566.98	.0
Average.....	116.31	2.91	.....	113.40	.0
Second subperiod:					
Total.....	561.61	14.45	2.57	547.16	.0
Average.....	112.32	2.89	.....	109.43	.0
Entire after period:					
Total.....	1,143.14	29.00	2.54	1,114.14	.0
Average.....	114.31	2.90	.....	111.41	.0

TABLE XV.—*Fat balances for Series VIII*—Continued.

[Averages are per day.]

## No. 12.

Period.	1 In food.	2 In feces.	3 In feces (2÷1).	4 Balance (1-2).	5 Sodium benzoate admin- istered (calcu- lated as benzoic acid).
<i>Fore period.</i>					
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Per cent.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	663.70	25.38	3.82	638.32	0.0
Average.....	132.74	5.08	.....	127.66	.0
Second subperiod:					
Total.....	660.01	21.86	3.31	638.15	.0
Average.....	132.00	4.37	.....	127.63	.0
Entire fore period:					
Total.....	1,323.71	47.24	3.57	1,276.47	.0
Average.....	132.37	4.72	.....	127.65	.0
<i>Preservative period.</i>					
First subperiod:					
Total.....	681.87	19.06	2.80	662.81	4.90
Average.....	136.37	3.81	.....	132.56	.98
Second subperiod:					
Total.....	645.99	16.25	2.52	629.74	7.50
Average.....	129.20	3.25	.....	125.95	1.50
Third subperiod:					
Total.....	611.74	13.67	2.23	598.07	10.00
Average.....	122.35	2.73	.....	119.67	2.00
Fourth subperiod:					
Total.....	557.39	28.20	5.06	529.19	.0
Average.....	111.48	5.64	.....	105.84	.0
Entire preservative period:					
Total.....	2,496.99	77.18	3.09	2,419.81	22.40
Average.....	124.85	3.86	.....	120.99	1.12
<i>After period.</i>					
First subperiod:					
Total.....	594.95	21.99	3.70	572.96	.0
Average.....	118.99	4.40	.....	114.59	.0
Second subperiod:					
Total.....	570.93	20.98	3.67	549.95	.0
Average.....	114.19	4.20	.....	109.99	.0
Entire after period:					
Total.....	1,165.88	42.97	3.68	1,122.91	.0
Average.....	116.59	4.30	.....	112.29	.0

TABLE XV.—*Fat balances for Series VIII—Continued.*

SUMMARIES.

[Averages are per man per day.]

Nos. 1 to 6, inclusive, omitting No. 3.

Period.	1 In food.	2 In feces.	3 In feces (2÷1).	4 Balance (1-2).	5 Benzoic acid admin- istered.
<i>Fore period.</i>					
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Per cent.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	2,431.59	93.26	3.83	2,338.33	0.0
Average.....	97.26	3.73		93.53	.0
Second subperiod:					
Total.....	2,358.71	97.84	4.15	2,260.87	.0
Average.....	94.35	3.91		90.43	.0
Entire fore period:					
Total.....	4,790.30	191.10	3.99	4,599.20	.0
Average.....	95.80	3.82		91.98	.0
<i>Preservative period.</i>					
First subperiod:					
Total.....	2,376.49	97.41	4.10	2,279.08	25.00
Average.....	95.06	3.90		91.16	1.00
Second subperiod:					
Total.....	2,257.36	76.91	3.41	2,180.45	37.50
Average.....	90.29	3.08		87.21	1.50
Third subperiod:					
Total.....	2,231.32	93.57	4.20	2,137.75	48.00
Average.....	89.25	3.74		85.51	1.92
First, second, and third subperiods:					
Total.....	6,865.17	267.89	3.90	6,597.28	110.50
Average.....	91.54	3.57		87.97	1.47
<i>After period.</i>					
First subperiod:					
Total.....	2,192.12	91.07	4.15	2,101.05	.0
Average.....	87.68	3.64		84.04	.0
Second subperiod:					
Total.....	2,207.22	70.86	3.21	2,136.36	.0
Average.....	88.29	2.83		85.46	.0
Entire after period:					
Total.....	4,399.34	161.93	3.68	4,237.41	.0
Average.....	87.99	3.24		84.75	.0

TABLE XV.—*Fat balances for Series VIII.*

SUMMARIES—Continued.

[Averages are per man per day.]

Nos. 7 to 12, inclusive.

Period.	1	2	3	4	5
	In food.	In feces.	In feces (2+1).	Balance (1-2).	Sodium benzoate admin- istered (calcu- lated as benzoic acid.
<i>Fore period.</i>					
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Per cent.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	3,288.87	110.16	3.35	3,178.71	0.0
Average.....	109.62	3.67	.....	105.95	.0
Second subperiod:					
Total.....	3,200.73	81.77	2.55	3,118.96	.0
Average.....	106.69	2.73	.....	103.96	.0
Entire fore period:					
Total.....	6,489.60	191.93	2.96	6,297.67	.0
Average.....	108.16	3.20	.....	104.96	0
<i>Preservative period.</i>					
First subperiod:					
Total.....	3,320.95	82.21	2.48	3,238.74	29.40
Average.....	110.70	2.74	.....	107.96	.98
Second subperiod:					
Total.....	3,132.15	112.02	3.58	3,020.13	45.00
Average.....	104.41	3.73	.....	100.68	1.50
Third subperiod:					
Total.....	3,110.90	76.23	2.45	3,034.67	58.00
Average.....	103.70	2.54	.....	101.16	1.93
First, second, and third subperiods:					
Total.....	9,564.00	270.46	2.83	9,293.54	132.40
Average.....	106.27	3.01	.....	103.26	1.47
<i>After period.</i>					
First subperiod:					
Total.....	3,055.70	108.35	3.55	2,947.35	.0
Average.....	101.86	3.61	.....	98.25	.0
Second subperiod:					
Total.....	2,901.98	109.88	3.79	2,792.10	.0
Average.....	96.73	3.66	.....	93.07	.0
Entire after period:					
Total.....	5,957.68	218.23	3.66	5,739.45	.0
Average.....	99.29	3.64	.....	95.65	.0



TABLE XV.—*Fat balances for Series VIII—Continued.*

## SUMMARIES—Continued.

[Averages are per man per day.]

Nos. 1 to 12, inclusive, omitting No. 3.

Period.	1 In food.	2 In feces.	3 In feces (2+1).	4 Balance (1-2).	5 Preserv- ative cal- culated as benzoic acid.
<i>Fore period.</i>					
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Per cent.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	5,720.46	203.42	3.56	5,517.04	0.0
Average.....	104.01	3.70	.....	100.31	.0
Second subperiod:					
Total.....	5,559.44	179.61	3.23	5,379.83	.0
Average.....	101.08	3.27	.....	97.81	.0
Entire fore period:					
Total.....	11,279.90	383.03	3.39	10,896.87	.0
Average.....	102.54	3.48	.....	99.06	.0
<i>Preservative period.</i>					
First subperiod:					
Total.....	5,697.44	179.62	3.15	5,517.82	54.40
Average.....	103.59	3.27	.....	100.32	.99
Second subperiod:					
Total.....	5,389.51	188.93	3.51	5,200.58	82.50
Average.....	97.99	3.44	.....	94.55	1.50
Third subperiod:					
Total.....	5,342.22	169.80	3.18	5,172.42	106.00
Average.....	97.13	3.07	.....	94.06	1.93
First, second, and third subperiods:					
Total.....	16,429.17	538.35	3.28	15,890.82	242.90
Average.....	99.57	3.26	.....	99.57	1.47
<i>After period.</i>					
First subperiod:					
Total.....	5,247.82	199.42	3.80	5,048.40	.0
Average.....	95.41	3.63	.....	91.78	.0
Second subperiod:					
Total.....	5,109.20	180.74	3.54	4,928.46	.0
Average.....	92.90	3.29	.....	89.61	.0
Entire after period:					
Total.....	10,357.02	380.16	3.67	9,976.86	.0
Average.....	94.16	3.46	.....	90.70	.0

TABLE XV.—*Fat balances for Series VIII—Continued.*

## SUMMARIES—Continued.

[Averages are per man per day.]

Nos. 1 and 4.

Period.	1	2	3	4	5
	In food.	In feces.	In feces (2÷1).	Balance (1-2).	Benzoic acid adminis- tered.
<i>Fore period.</i>					
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Per cent.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	1,049.95	27.92	2.66	1,022.03	0.0
Average.....	104.99	2.79	.....	102.20	.0
Second subperiod:					
Total.....	1,008.33	30.97	3.07	977.36	.0
Average.....	100.83	3.10	.....	97.73	.0
Entire fore period:					
Total.....	2,058.28	58.89	2.86	1,999.39	.0
Average.....	102.91	2.94	.....	99.97	.0
<i>Preservative period.</i>					
First subperiod:					
Total.....	968.07	31.87	3.29	936.20	10.00
Average.....	96.81	3.19	.....	93.62	1.00
Second subperiod:					
Total.....	952.56	22.83	2.40	929.73	15.00
Average.....	95.26	2.28	.....	92.98	1.50
Third subperiod:					
Total.....	929.92	28.52	3.07	901.40	20.00
Average.....	92.99	2.85	.....	90.14	2.00
Fourth subperiod:					
Total.....	931.83	22.82	2.45	909.01	25.00
Average.....	93.18	2.28	.....	90.90	2.50
Entire preservative period:					
Total.....	3,782.38	106.04	2.80	3,676.34	70.00
Average.....	94.56	2.65	.....	91.91	1.75
<i>After period.</i>					
First subperiod:					
Total.....	923.12	28.81	3.12	894.31	.0
Average.....	92.31	2.88	.....	89.43	.0
Second subperiod:					
Total.....	946.70	25.84	2.73	920.86	.0
Average.....	94.67	2.58	.....	92.09	.0
Entire after period:					
Total.....	1,869.82	54.65	2.92	1,815.17	.0
Average.....	93.49	2.73	.....	90.76	.0

## CALORIES BALANCE.

This study is of interest, as an increase of calories in the feces would show a disposition on the part of the preservative to retard the digestive processes, whereas an increase of calories in the urine would indicate a tendency to increase the katabolic activities.

## INDIVIDUAL DATA.

## No. 1.

In the case of No. 1 it is noticed that there is no change in the calories in the feces in the fore and preservative periods, but they are materially increased in the after period, and there is a slight decrease in the numbers ingested. There is a very slight increase in the calories in the urine in the preservative period and they are

diminished notably in the after period. The total elimination is increased throughout, both in actual amount and in percentage, due chiefly in the preservative period to the increase in the urine. The variations in the after period in this case are of equal interest, as there was a marked tendency to increase the calories of the feces and decrease the calories of the urine.

*No. 2.*

In the case of No. 2 there is a notable increase in the calories of the feces in the preservative period (34 calories daily, or 1.06 per cent), and this increase is continued, though not to the same degree, in the after period, as compared with the fore period. There is also a very slight increase in the calories of the urine in the preservative period (6 calories, or 0.2 per cent), but there is a tendency to return to the conditions of the fore period in the after period. The increase in total elimination of calories is 1.27 per cent in the preservative period, and this increase is practically maintained in the after period. In this instance the benzoic acid appears to have decreased to a slight extent the absorption of the calories in the intestinal canal.

*No. 3.*

The data for No. 3 show a very slight increase in the calories in the feces in the preservative period (8 calories) and a notable decrease in the after period (31 calories) as compared with the preservative period, accompanied by a marked decrease in the number ingested of 232 calories daily. There is a progressive, though slight, decrease in the calories in the urine from the beginning to the end of the observation. The percentage data show an increase of 0.61 per cent in total elimination, and a marked decrease, 1.46 per cent, in the after period, the changes being due to the increase in calories in the feces in the preservative period and the decrease in the after period indicating a very slight inhibition of the absorption of the heat elements under the influence of the preservative.

*No. 4.*

The data for No. 4 show a slight decrease in the calories in the feces both in the preservative and after periods. There is a very slight decrease in the calories in the urine in the preservative period. The percentage data show this total increase to amount to only 0.17 per cent, with virtually no change in the after period. These figures are not of sufficient magnitude to warrant any conclusion, but the tendency shown is toward an increased assimilation.

*No. 5.*

In the case of No. 5 there is a notable increase in the calories in the feces in the preservative period (19 calories daily), and this in-

crease is continued, though not to the same extent, in the after period. The calories in the urine also increased by 6 in the preservative period and decreased by 5 in the after period. The percentage figures show an increase in total elimination of 1.07 per cent and a slight decrease in the after period. The preservative appears again to have decreased slightly the absorption of the calories in the alimentary canal.

*No. 6.*

The data for No. 6 show a marked decrease in the calories in the feces during the preservative period, and this decrease is continued in the after period. There is a slight decrease in the calories in the urine throughout. The decrease is principally in the feces, as is shown by the percentage data, the total decrease in elimination amounting to about 1 per cent, with an almost equal decrease in the after period. In this case the preservative seems to have increased the absorption of the calories in the alimentary canal.

*No. 7.*

In the case of No. 7 there is again a decrease in the calories in the feces in the preservative period and a notable increase in the after period. The calories in the urine decrease throughout the observation. The percentage data show a slight decrease, both in the feces and urine, in the preservative period, the decrease in the amount ingested modifying the percentage results, and an increase in the after period. Here there is apparently a stimulation of the absorption of the calories in the intestinal canal and at the same time an inhibition of the katabolic processes to which the solids in the urine are due.

*No. 8.*

In the case of No. 8 there is a notable increase in the calories in the feces in the preservative period, and this increase is augmented in the after period. There is also a slight increase in the calories in the urine both in the preservative and after periods. The percentage data show a total increase of 0.82 per cent, which is slightly increased in the after period, the increase in the feces being relatively greater than that in the urine. In this instance the benzoic acid appears to have decreased the absorption of the calories in the intestinal canal and to have stimulated to a slight degree the katabolic activities which produce solids in the urine.

*No. 9.*

The data for No. 9 show a decrease of 27 calories in the feces during the preservative period, which, however, amounts to only 0.87 per cent, and an increase in the after period over the fore period of 16 calories, or 0.68 per cent. The calories in the urine increase very



slightly throughout, and the percentage data for total elimination show a slight decrease in the preservative period and an increase in the after period to a figure exceeding that of the fore period. There is again shown a tendency to increase assimilation in the preservative period, while the katabolic activities, evidenced by the excretion of solids in the urine, are practically unaffected, a negligible increase being recorded.

*No. 10.*

The data for No. 10 show an increase of 10 calories daily in the feces during the preservative period and a further increase of 12 calories in the after period. The percentage figures also increase throughout. There is also a slight increase in the calories in the urine in the preservative period, while during the after period they are practically the same as in the fore period. There is a marked decrease in ingestion in the preservative period, and the percentage figures for total elimination increase very slightly throughout. There is a slight influence exerted by the benzoate of soda apparently to increase the excretion of calories, both in the feces and the urine.

*No. 11.*

No. 11 shows a notable increase in the calories in the feces in the preservative period, and this increase is practically maintained in the after period. There is also an increase of the solids of the urine in the preservative period, but this increase is lost during the after period, in which the number falls below that of the fore period. The percentage data show an increase in total excretion of 1.04 per cent, with a tendency to return to the conditions of the fore period during the after period. The greater increase is in the feces, indicating a tendency to decrease assimilation, and to a less degree the katabolic activities are increased.

*No. 12.*

In the case of No. 12, there is a slight loss of calories in the feces during the preservative period, and this figure is maintained during the after period. In the urine there is a slight increase during the preservative period and a slight loss during the after period. The percentage data show the same relative changes as do the actual amounts, but the percentage of total elimination remains practically unchanged in the preservative period. These data show a very slight tendency to increase assimilation, but also increase the katabolic activities, as is evidenced by the increase of calories in the urine.

## SUMMARIES.

In the case of Nos. 1 and 4, there is practically no effect upon the calorization of the heat-forming elements of the food as indicated by the calories balance, the figures being remarkably constant throughout.

The mass action of the benzoic acid and the benzoate of soda as affecting the calories in the excretion may be compared in the summaries for Nos. 1, 2, 4, 5, and 6, and for Nos. 7 to 12, inclusive, omitting the fourth preservative subperiod, while the summary for the eleven men, omitting No. 3 and the fourth preservative period, shows the average result for the whole observation.

In the summary for Nos. 1, 2, 4, 5, and 6, there is seen to be a slight increase in the calories in the feces during the preservative period and a decrease in the after period. In the urine there is also a slight increase in the preservative period, while in the after period the number falls below that of the fore period. Expressed as percentages of the calories ingested it is seen that 3.21 per cent is found in the feces in the fore period, 3.40 per cent in the preservative period, and 3.24 per cent in the after period. These data show a slight retarding influence upon the metabolic activities in so far as the utilization of the calories is concerned. The percentage of calories in the food excreted in the urine in the fore period is 2.49, in the preservative period 2.62, and in the after period 2.52. These data also show a slight influence on the part of the preservative to increase the percentage of metabolized solids excreted. The percentage of total elimination, however, is increased very slightly in the preservative period and decreases again in the after period.

In the summary for Nos. 7 to 12, inclusive, it is seen that there is no change in the quantity of calories in the feces in the fore and preservative periods, but a notable increase in the after period. In the case of the urine, there is a slight increase in the calories during the preservative period, but in the after period the figure falls below that of the fore period. Expressed in percentages of the calories ingested it is seen that 2.92 per cent is excreted in the feces in the fore period, 2.96 per cent in the preservative period, and 3.60 per cent in the after period; and in the urine 2.35 per cent in the fore period, 2.51 per cent in the preservative period, and 2.37 per cent in the after period. The general effect is not very marked, but tends toward restricting slightly the absorption of the calories and at the same time increasing slightly the excretion of solids in the urine.

The average data for the eleven men show a slight increase in the calories in the feces in the preservative period, and this is accentuated in the after period. There is also a slight increase in the calories of the urine in the preservative period, but this is lost in the after

period. Expressed as percentages of the total calories ingested, 3.05 per cent appears in the feces in the fore period, 3.15 per cent in the preservative period, and 3.44 per cent in the after period, and in the urine 2.41 per cent appears in the fore period, 2.56 per cent in the preservative period, and 2.44 per cent in the after period. There is, therefore, manifested a uniform but very slight inclination on the part of the preservatives, benzoic acid and benzoate of soda, to disturb the metabolic processes, with a tendency toward decreased assimilation and increased katabolic activity.

 TABLE XVI.—*Calories balances for Series VIII.*

[Averages are per day.]

No. 1.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Balance (1-4).	9 Ben- zoic acid admin- istered.
<i>Fore period.</i>									
First subperiod:	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Calories.</i>	<i>Grams.</i>
Total.....	15,510	225	329	554	1.45	2.12	3.57	14,956	0.0
Average.....	3,102	45	66	111				2,991	.0
Second subperiod:									
Total.....	15,999	355	372	727	2.22	2.33	4.54	15,272	.0
Average.....	3,200	71	74	145				3,055	.0
Entire fore period:									
Total.....	31,509	580	701	1,281	1.84	2.22	4.07	30,228	.0
Average.....	3,151	58	70	128				3,023	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	15,244	340	375	715	2.23	2.46	4.70	14,529	5.00
Average.....	3,049	68	75	143				2,906	1.00
Second subperiod:									
Total.....	15,179	232	345	577	1.53	2.27	3.80	14,602	7.50
Average.....	3,036	46	69	115				2,921	1.50
Third subperiod:									
Total.....	14,952	360	372	732	2.41	2.49	4.90	14,220	10.00
Average.....	2,990	72	74	146				2,844	2.00
Fourth subperiod:									
Total.....	15,202	218	363	581	1.43	2.30	3.82	14,621	12.50
Average.....	3,040	44	73	116				2,924	2.50
Entire preservative period:									
Total.....	60,577	1,150	1,455	2,605	1.90	2.40	4.30	57,972	35.00
Average.....	3,029	58	73	130				2,899	1.75
<i>After period.</i>									
First subperiod:									
Total.....	14,736	348	329	677	2.36	2.23	4.59	14,055	.0
Average.....	2,947	70	66	135				2,812	.0
Second subperiod:									
Total.....	14,582	340	314	654	2.33	2.15	4.48	13,928	.0
Average.....	2,916	68	63	131				2,785	.0
Entire after period:									
Total.....	29,318	688	643	1,331	2.35	2.19	4.54	27,987	.0
Average.....	2,932	69	64	133				2,799	.0



TABLE XVI.—*Calories balances for Series VIII—Continued.*

[Averages are per day.]

## No. 2.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Balance (1-4).	9 Ben- zoic acid admin- istered.
<i>Fore period.</i>									
First subperiod:	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Calories.</i>	<i>Grams.</i>
Total.....	16,809	472	412	884	2.81	2.45	5.25	15,925	0.0
Average.....	3,362	94	82	177				3,185	.0
Second subperiod:									
Total.....	17,143	661	510	1,171	3.86	2.97	6.83	15,972	.0
Average.....	3,429	132	102	234				3,195	.0
Entire fore period:									
Total.....	33,952	1,133	922	2,055	3.34	2.72	6.05	31,897	.0
Average.....	3,395	113	92	206				3,190	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	17,081	721	498	1,219	4.22	2.92	7.14	15,862	5.00
Average.....	3,416	144	100	244				3,172	1.00
Second subperiod:									
Total.....	16,666	727	486	1,213	4.36	2.92	7.28	15,453	7.50
Average.....	3,333	145	97	243				3,090	1.50
Third subperiod:									
Total.....	16,981	770	499	1,269	4.53	2.94	7.47	15,712	10.00
Average.....	3,396	154	100	254				3,142	2.00
Fourth subperiod:									
Total.....	16,108	724	469	1,193	4.49	2.91	7.41	14,915	2.50
Average.....	3,222	145	94	239				2,983	.50
Entire preservative period:									
Total.....	66,836	2,942	1,952	4,894	4.40	2.92	7.32	61,942	25.00
Average.....	3,342	147	98	245				3,097	1.25
<i>After period.</i>									
First subperiod:									
Total.....	16,148	714	464	1,178	4.42	2.87	7.30	14,970	.0
Average.....	3,230	143	93	236				2,994	.0
Second subperiod:									
Total.....	16,123	625	465	1,090	3.88	2.88	6.76	15,033	.0
Average.....	3,225	125	93	218				3,007	.0
Entire after period:									
Total.....	32,271	1,339	929	2,268	4.15	2.88	7.03	30,003	.0
Average.....	3,227	134	93	227				3,000	.0



TABLE XVI.—*Calories balances for Series VIII—Continued.*

[Averages are per day.]

## No. 3.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Balance (1-4).	9 Ben- zoic acid admin- istered.
<i>Fore period.</i>									
First subperiod:	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Calories.</i>	<i>Grams.</i>
Total.....	16,790	453	400	853	2.70	2.38	5.08	15,937	0.0
Average.....	3,358	91	80	171	.....	.....	.....	3,187	.0
Second subperiod:									
Total.....	16,762	449	408	857	2.68	2.43	5.11	15,905	.0
Average.....	3,352	90	82	171	.....	.....	.....	3,181	.0
Entire fore period:									
Total.....	33,552	902	808	1,710	2.69	2.41	5.10	31,842	.0
Average.....	3,355	90	81	171	.....	.....	.....	3,184	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	17,061	536	415	951	3.14	2.43	5.57	16,110	5.00
Average.....	3,412	107	83	190	.....	.....	.....	3,222	1.00
Second subperiod:									
Total.....	16,897	591	420	1,011	3.50	2.49	5.98	15,886	7.50
Average.....	3,379	118	84	202	.....	.....	.....	3,177	1.50
Third subperiod:									
Total.....	12,320	239	402	641	1.94	3.26	5.20	11,679	1.00
Average.....	2,464	48	80	128	.....	.....	.....	2,336	.20
Fourth subperiod:									
Total.....	16,180	595	369	964	3.68	2.28	5.96	15,216	.0
Average.....	3,236	119	74	193	.....	.....	.....	3,043	.0
Entire preservative period:									
Total.....	62,458	1,961	1,606	3,567	3.14	2.57	5.71	58,891	13.50
Average.....	3,123	98	80	178	.....	.....	.....	2,945	.68
<i>After period.</i>									
First subperiod:									
Total.....	17,097	351	398	749	2.05	2.33	4.38	16,348	.0
Average.....	3,419	70	80	150	.....	.....	.....	3,269	.0
Second subperiod:									
Total.....	16,737	317	371	688	1.89	2.22	4.11	16,049	.0
Average.....	3,347	63	74	138	.....	.....	.....	3,209	.0
Entire after period:									
Total.....	33,834	668	769	1,437	1.97	2.27	4.25	32,397	.0
Average.....	3,383	67	77	144	.....	.....	.....	3,240	.0

TABLE XVI.—*Calories balances for Series VIII—Continued.*

[Averages are per day.]

## No. 4.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Balance (1-4).	9 Ben- zoic acid admin- istered.
<i>Fore period.</i>									
First subperiod:	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Calories.</i>	<i>Grams.</i>
Total.....	13,587	425	342	767	3.13	2.52	5.65	12,820	0.0
Average.....	2,717	85	68	153				2,564	.0
Second subperiod:									
Total.....	13,072	344	398	742	2.63	3.04	5.68	12,330	.0
Average.....	2,614	69	80	148				2,466	.0
Entire fore period:									
Total.....	26,659	769	740	1,509	2.88	2.78	5.66	25,150	.0
Average.....	2,666	77	74	151				2,515	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	13,238	388	383	771	2.93	2.89	5.82	12,467	5.00
Average.....	2,648	78	77	154				2,494	1.00
Second subperiod:									
Total.....	12,981	333	356	689	2.57	2.74	5.31	12,292	7.50
Average.....	2,596	67	71	138				2,458	1.50
Third subperiod:									
Total.....	13,087	333	348	681	2.54	2.66	5.20	12,406	10.00
Average.....	2,617	67	70	136				2,481	2.00
Fourth subperiod:									
Total.....	12,746	366	349	715	2.87	2.74	5.61	12,031	12.50
Average.....	2,549	73	70	143				2,406	2.50
Entire preservative period:									
Total.....	52,052	1,420	1,436	2,856	2.73	2.76	5.49	49,196	35.00
Average.....	2,603	71	72	143				2,460	1.75
<i>After period.</i>									
First subperiod:									
Total.....	12,920	383	397	780	2.96	3.07	6.04	12,140	.0
Average.....	2,584	77	79	156				2,428	.0
Second subperiod:									
Total.....	13,137	306	337	643	2.33	2.57	4.89	12,494	.0
Average.....	2,627	61	67	129				2,498	.0
Entire after period:									
Total.....	26,057	689	734	1,423	2.64	2.82	5.46	24,634	.0
Average.....	2,606	69	73	142				2,463	.0

TABLE XVI.—*Calories balances for Series VIII.*—Continued.

[Averages are per day.]

No. 5.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Balance (1-4).	9 Ben- zoic acid admin- istered.
<i>Fore period.</i>									
First subperiod:	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Calories.</i>	<i>Grams.</i>
Total.....	11,279	236	a 236	472	2.09	2.09	4.18	10,807	0.0
Average.....	2,256	47	47	94	.....	.....	.....	2,161	.0
Second subperiod:									
Total.....	11,829	391	239	630	3.31	2.02	5.33	11,199	.0
Average.....	2,366	78	48	126	.....	.....	.....	2,240	.0
Entire fore period:									
Total.....	23,108	627	475	1,102	2.71	2.06	4.77	22,006	.0
Average.....	2,311	63	48	110	.....	.....	.....	2,201	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	11,767	428	251	679	3.64	2.13	5.77	11,088	5.00
Average.....	2,353	86	50	136	.....	.....	.....	2,218	1.00
Second subperiod:									
Total.....	11,827	354	a 280	634	2.99	2.37	5.36	11,193	7.50
Average.....	2,365	71	56	127	.....	.....	.....	2,238	1.50
Third subperiod:									
Total.....	11,610	375	302	677	3.23	2.60	5.83	10,933	8.00
Average.....	2,322	75	60	135	.....	.....	.....	2,187	1.60
Fourth subperiod:									
Total.....	11,298	476	a 249	725	4.21	2.20	6.42	10,573	3.00
Average.....	2,260	95	50	145	.....	.....	.....	2,115	.60
Entire preservative period:									
Total.....	46,502	1,633	1,082	2,715	3.51	2.33	5.84	43,787	23.50
Average.....	2,325	83	54	136	.....	.....	.....	2,189	1.18
<i>After period.</i>									
First subperiod:									
Total.....	11,751	464	a 256	720	3.95	2.18	6.13	11,031	.0
Average.....	2,350	93	51	144	.....	.....	.....	2,206	.0
Second subperiod:									
Total.....	11,748	306	236	542	2.60	2.00	4.61	11,206	.0
Average.....	2,350	61	47	108	.....	.....	.....	2,242	.0
Entire after period:									
Total.....	23,499	770	492	1,262	3.28	2.09	5.37	22,237	.0
Average.....	2,350	77	49	126	.....	.....	.....	2,224	.0

a Daily average added to complete record.

TABLE XVI.—*Calories balances for Series VIII—Continued.*

[Averages are per day.]

No. 6.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Balance (1-4).	9 Ben- zoic acid admin- istered.
<i>Fore period.</i>	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Calories.</i>	<i>Grams.</i>
First subperiod:									
Total.....	14,786	850	375	1,225	5.75	2.54	8.28	13,561	0.0
Average.....	2,957	170	75	245				2,712	.0
Second subperiod:									
Total.....	14,755	693	390	1,083	4.70	2.64	7.34	13,672	.0
Average.....	2,951	139	78	217				2,734	.0
Entire fore period:									
Total.....	29,541	1,543	765	2,308	5.22	2.59	7.81	27,233	.0
Average.....	2,954	154	77	231				2,723	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	15,042	706	362	1,068	4.69	2.41	7.10	13,974	5.00
Average.....	3,008	141	72	214				2,794	1.00
Second subperiod:									
Total.....	14,139	529	373	902	3.74	2.64	6.38	13,237	7.50
Average.....	2,828	106	75	180				2,648	1.50
Third subperiod:									
Total.....	13,936	663	367	1,030	4.76	2.63	7.39	12,906	10.00
Average.....	2,787	133	73	206				2,581	2.00
Fourth subperiod:									
Total.....	13,631	549	358	907	4.03	2.63	6.65	12,724	.0
Average.....	2,726	110	72	181				2,545	.0
Entire preservative period:									
Total.....	56,748	2,447	1,460	3,907	4.31	2.57	6.88	52,841	22.50
Average.....	2,837	122	73	195				2,642	1.13
<i>After period.</i>									
First subperiod:									
Total.....	13,971	655	366	1,021	4.69	2.62	7.31	12,950	.0
Average.....	2,794	131	73	204				2,590	.0
Second subperiod:									
Total.....	<sup>a</sup> 14,275	<sup>a</sup> 319	<sup>a</sup> 341	660	2.23	2.39	4.62	13,615	.0
Average.....	2,855	64	68	132				2,723	.0
Entire after period:									
Total.....	28,246	974	707	1,681	3.45	2.50	5.95	26,565	.0
Average.....	2,825	97	71	168				2,657	.0

<sup>a</sup> Daily average added to complete record.



TABLE XVI.—Calories balances for Series VIII—Continued.

[Averages are per day.]

No. 7.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Balance (1-4).	9 Sodium benzoate administered (calculated as benzoic acid).
<i>Fore period.</i>	<i>Calo-ries.</i>	<i>Calo-ries.</i>	<i>Calo-ries.</i>	<i>Calo-ries.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Calories.</i>	<i>Grams.</i>
First subperiod:									
Total.....	13,595	483	350	833	3.55	2.57	6.13	12,762	0.0
Average.....	2,719	97	70	167				2,552	.0
Second subperiod:									
Total.....	14,050	451	349	800	3.21	2.48	5.69	13,250	.0
Average.....	2,810	90	70	160				2,650	.0
Entire fore period:									
Total.....	27,645	934	699	1,633	3.38	2.53	5.91	26,012	.0
Average.....	2,764	93	70	163				2,601	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	13,286	402	349	751	3.03	2.63	5.65	12,535	4.90
Average.....	2,657	80	70	150				2,507	.98
Second subperiod:									
Total.....	13,659	554	316	870	4.06	2.31	6.37	12,789	7.50
Average.....	2,732	111	63	174				2,558	1.50
Third subperiod:									
Total.....	13,892	379	306	685	2.73	2.20	4.93	13,207	10.00
Average.....	2,778	76	61	137				2,661	2.00
Fourth subperiod:									
Total.....	12,105	375	342	717	3.10	2.83	5.92	11,388	6.50
Average.....	2,421	75	68	143				2,278	1.30
Entire preservative period:									
Total.....	52,942	1,710	1,313	3,023	3.23	2.48	5.71	49,919	28.90
Average.....	2,647	86	66	151				2,496	1.45
<i>After period.</i>									
First subperiod:									
Total.....	12,734	511	287	798	4.01	2.25	6.27	11,936	.0
Average.....	2,547	102	57	160				2,387	.0
Second subperiod:									
Total.....	11,046	598	303	901	5.41	2.74	8.16	10,145	.0
Average.....	2,209	120	61	180				2,029	.0
Entire after period:									
Total.....	23,780	1,109	590	1,699	4.66	2.48	7.14	22,081	.0
Average.....	2,378	111	59	170				2,208	.0

TABLE XVI.—*Calories balances for Series VIII—Continued.*

[Averages are per day.]

No. 8.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Bal- ance (1-4).	9 Sodium benzo- ate ad- minis- tered (calcu- lated as benzoic acid).
<i>Fore period.</i>	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Calories.</i>	<i>Grams.</i>
First subperiod:									
Total.....	13,766	622	312	934	4.52	2.27	6.78	12,832	0.0
Average.....	2,753	124	62	187				2,566	.0
Second subperiod:									
Total.....	14,078	235	337	572	1.67	2.39	4.06	13,506	.0
Average.....	2,816	47	67	114				2,702	.0
Entire fore period:									
Total.....	27,844	857	649	1,506	3.08	2.33	5.41	26,338	.0
Average.....	2,784	86	65	151				2,634	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	14,170	550	352	902	3.88	2.48	6.37	13,268	4.90
Average.....	2,834	110	70	180				2,654	.98
Second subperiod:									
Total.....	13,578	487	<sup>a</sup> 346	833	3.59	2.55	6.13	12,745	7.50
Average.....	2,716	97	69	167				2,549	1.50
Third subperiod:									
Total.....	13,726	483	332	815	3.52	2.42	5.94	12,911	10.00
Average.....	2,745	97	66	163				2,582	2.00
Fourth subperiod:									
Total.....	13,417	524	346	870	3.91	2.58	6.48	12,547	12.50
Average.....	2,683	105	69	174				2,509	2.50
Entire preservative period:									
Total.....	54,891	2,044	1,376	3,420	3.72	2.51	6.23	51,471	34.90
Average.....	2,744	102	69	171				2,573	1.75
<i>After period.</i>									
First subperiod:									
Total.....	13,969	539	351	890	3.86	2.51	6.37	13,079	.0
Average.....	2,794	108	70	178				2,616	.0
Second subperiod:									
Total.....	13,696	571	352	923	4.17	2.57	6.74	12,773	.0
Average.....	2,739	114	70	185				2,554	.0
Entire after period:									
Total.....	27,665	1,110	703	1,813	4.01	2.54	6.55	25,852	.0
Average.....	2,767	111	70	181				2,585	.0

<sup>a</sup> Daily average added to complete record.

TABLE XVI.—*Calories balances for Series VIII—Continued.*

[Averages are per day.]

No. 9.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Balance (1-4).	9 Sodium benzoate administered (calculated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Calo-ries.</i>	<i>Calo-ries.</i>	<i>Calo-ries.</i>	<i>Calo-ries.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Calories.</i>	<i>Grams.</i>
Total.....	14,478	457	<sup>a</sup> 389	846	3.16	2.69	5.85	13,632	0.0
Average.....	2,895	91	78	169				2,726	.0
Second subperiod:									
Total.....	14,345	392	386	778	2.73	2.69	5.42	13,567	.0
Average.....	2,869	78	77	156				2,713	.0
Entire fore period:									
Total.....	28,823	849	775	1,624	2.95	2.69	5.64	27,199	.0
Average.....	2,882	85	78	162				2,720	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	14,261	214	<sup>a</sup> 399	613	1.50	2.80	4.30	13,648	4.90
Average.....	2,852	43	80	123				2,729	.98
Second subperiod:									
Total.....	13,990	462	366	828	3.30	2.62	5.92	13,162	7.50
Average.....	2,798	92	73	166				2,632	1.50
Third subperiod:									
Total.....	13,775	198	427	625	1.44	3.10	4.54	13,150	10.00
Average.....	2,755	40	85	125				2,630	2.00
First, second, and third subperiods:									
Total.....	42,026	874	1,192	2,066	2.08	2.84	4.92	39,960	22.40
Average.....	2,802	58	79	138				2,664	<sup>b</sup> 1.12
<i>After period</i>									
First subperiod:									
Total.....	13,914	414	402	816	2.98	2.80	5.87	13,098	.0
Average.....	2,782	83	80	163				2,619	.0
Second subperiod:									
Total.....	13,774	592	413	1,005	4.30	3.00	7.30	12,769	.0
Average.....	2,755	118	83	201				2,554	.0
Entire after period:									
Total.....	27,688	1,006	815	1,821	3.63	2.94	6.58	25,867	.0
Average.....	2,769	101	82	182				2,587	.0

<sup>a</sup> Daily average added to complete record.<sup>b</sup> Average for 20 days.

TABLE XVI.—*Calories balances for Series VIII—Continued.*

[Averages are per day.]

No. 10.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Balance (1-4).	9 Sodium benzoate administered (calculated as benzoic acid).
<i>Fore period.</i>	<i>Calo-ries.</i>	<i>Calo-ries.</i>	<i>Calo-ries.</i>	<i>Calo-ries.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Calories.</i>	<i>Grams.</i>
First subperiod:									
Total.....	14,262	508	304	812	3.56	2.13	5.69	13,450	0.0
Average.....	2,852	102	61	162				2,690	.0
Second subperiod:									
Total.....	15,125	266	326	592	1.76	2.16	3.92	14,533	.0
Average.....	3,025	53	65	118				2,907	.0
Entire fore period:									
Total.....	29,387	774	630	1,404	2.63	2.14	4.78	27,983	.0
Average.....	2,939	77	63	140				2,798	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	14,344	253	381	634	1.76	2.66	4.42	13,710	4.90
Average.....	2,869	51	76	127				2,742	.98
Second subperiod:									
Total.....	14,336	728	<sup>a</sup> 354	1,082	5.08	2.48	7.55	13,254	7.50
Average.....	2,867	146	71	216				2,651	1.50
Third subperiod:									
Total.....	13,390	395	307	702	2.95	2.29	5.24	12,688	8.00
Average.....	2,678	79	61	140				2,538	1.60
Fourth subperiod:									
Total.....	12,107	360	<sup>a</sup> 272	632	2.97	2.25	5.22	11,475	.0
Average.....	2,421	72	54	126				2,295	.0
Entire preservative period:									
Total.....	54,178	1,736	1,314	3,050	3.20	2.42	5.63	51,128	20.40
Average.....	2,709	87	66	152				2,557	1.02
<i>After period.</i>									
First subperiod:									
Total.....	14,442	500	333	833	3.46	2.31	5.77	13,609	.0
Average.....	2,888	100	67	167				2,721	.0
Second subperiod:									
Total.....	13,533	491	306	797	3.63	2.26	5.89	12,736	.0
Average.....	2,707	98	61	159				2,548	.0
Entire after period:									
Total.....	27,975	991	639	1,630	3.54	2.28	5.83	26,345	.0
Average.....	2,798	99	64	163				2,635	.0

<sup>a</sup> Average added to complete record.



TABLE XVI.—*Calories balances for Series VIII—Continued.*

[Averages are per day.]

## No. 11.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Balance (1-4).	9 Sodium benzoate administered (calculated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Calories.</i>	<i>Grams.</i>
Total.....	16,085	359	402	761	2.23	2.50	4.73	15,324	0.0
Average.....	3,217	72	80	151	.....	.....	.....	3,066	.0
Second period:									
Total.....	17,022	393	390	783	2.31	2.29	4.60	16,239	.0
Average.....	3,404	79	78	157	.....	.....	.....	3,247	.0
Entire fore period:									
Total.....	33,107	752	792	1,544	2.27	2.39	4.66	31,563	.0
Average.....	3,311	75	79	154	.....	.....	.....	3,156	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	17,278	587	459	1,046	3.40	2.66	6.05	16,232	4.90
Average.....	3,456	117	92	209	.....	.....	.....	3,247	.98
Second subperiod:									
Total.....	16,413	549	382	931	3.34	2.33	5.67	15,482	7.50
Average.....	3,283	110	76	186	.....	.....	.....	3,097	1.50
Third subperiod:									
Total.....	16,864	359	474	833	2.13	2.81	4.94	16,031	10.00
Average.....	3,373	72	95	167	.....	.....	.....	3,206	2.00
Fourth subperiod:									
Total.....	15,114	491	444	935	3.25	2.94	6.19	14,179	2.50
Average.....	3,023	98	89	187	.....	.....	.....	2,836	.50
Entire preservative period:									
Total.....	65,669	1,986	1,759	3,745	3.02	2.68	5.70	61,924	24.90
Average.....	3,283	99	88	187	.....	.....	.....	3,096	1.25
<i>After period.</i>									
First subperiod:									
Total.....	16,979	503	257	760	2.96	1.51	4.48	16,219	.0
Average.....	3,396	101	51	152	.....	.....	.....	3,244	.0
Second subperiod:									
Total.....	16,521	468	425	893	2.83	2.57	5.41	15,628	.0
Average.....	3,304	94	85	179	.....	.....	.....	3,125	.0
Entire after period:									
Total.....	33,500	971	682	1,653	2.90	2.04	4.93	31,847	.0
Average.....	3,350	97	68	165	.....	.....	.....	3,185	.0

TABLE XVI.—*Calories balances for Series VIII*—Continued.

[Averages are per day.]

No. 12.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4+1).	8 Balance (1-4).	9 Sodium benzoate administered (calculated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Cal- ories.</i>	<i>Cal- ories.</i>	<i>Cal- ories.</i>	<i>Cal- ories.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Calories.</i>	<i>Grams.</i>
Total.....	17,640	636	355	991	3.61	2.01	5.62	16,649	0.0
Average.....	3,528	127	71	198				3,330	.0
Second subperiod:									
Total.....	18,151	535	385	920	2.95	2.12	5.07	17,231	.0
Average.....	3,630	107	77	184				3,446	.0
Entire fore period:									
Total.....	35,791	1,171	740	1,911	3.27	2.07	5.34	33,880	.0
Average.....	3,579	117	74	191				3,388	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	18,197	522	427	949	2.87	2.35	5.22	17,248	4.90
Average.....	3,639	104	85	190				3,449	.98
Second subperiod:									
Total.....	17,744	449	403	852	2.53	2.27	4.80	16,892	7.50
Average.....	3,549	90	81	170				3,379	1.50
Third subperiod:									
Total.....	17,163	433	404	837	2.52	2.35	4.88	16,326	10.00
Average.....	3,433	87	81	167				3,266	2.00
Fourth subperiod:									
Total.....	15,809	686	346	1,032	4.34	2.19	6.53	14,777	.0
Average.....	3,162	137	69	206				2,956	.0
Entire preservative period:									
Total.....	68,913	2,090	1,580	3,670	3.03	2.29	5.33	65,243	22.40
Average.....	3,446	105	79	184				3,262	1.12
<i>After period.</i>									
First subperiod:									
Total.....	16,733	521	355	876	3.11	2.12	5.24	15,857	.0
Average.....	3,347	104	71	175				3,172	.0
Second subperiod:									
Total.....	16,069	528	330	858	3.29	2.05	5.34	15,211	.0
Average.....	3,214	106	66	172				3,042	.0
Entire after period:									
Total.....	32,802	1,049	685	1,734	3.20	2.09	5.29	31,068	.0
Average.....	3,280	105	69	173				3,107	.0

TABLE XVI.—*Calories balances for Series VIII—Continued.*

## SUMMARIES.

[Averages are per man per day.]

Nos. 1 and 4.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Balance (1-4).	9 Ben- zoic acid admin- istered.
<i>Fore period.</i>									
First subperiod:	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Calories.</i>	<i>Grams.</i>
Total.....	29,097	650	671	1,321	2.23	2.31	4.54	27,776	0.0
Average.....	2,910	65	67	132				2,778	.0
Second subperiod:									
Total.....	29,071	699	770	1,469	2.40	2.65	5.05	27,602	.0
Average.....	2,907	70	77	147				2,700	.0
Entire fore period:									
Total.....	58,168	1,349	1,441	2,790	2.32	2.48	4.80	55,378	.0
Average.....	2,908	67	72	139				2,769	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	28,482	728	758	1,486	2.56	2.66	5.22	26,996	10.00
Average.....	2,848	73	76	149				2,699	1.00
Second subperiod:									
Total.....	28,160	565	701	1,266	2.01	2.49	4.50	26,894	15.00
Average.....	2,816	57	70	127				2,689	1.50
Third subperiod:									
Total.....	28,039	693	720	1,413	2.47	2.57	5.04	26,626	20.00
Average.....	2,804	69	72	141				2,663	2.00
Fourth subperiod:									
Total.....	27,948	584	712	1,296	2.09	2.55	4.64	26,652	25.00
Average.....	2,795	58	71	130				2,665	2.50
Entire preservative period:									
Total.....	112,629	2,570	2,891	5,461	2.28	2.57	4.85	107,168	70.00
Average.....	2,816	64	72	137				2,679	1.75
<i>After period.</i>									
First subperiod:									
Total.....	27,656	731	726	1,457	2.64	2.63	5.27	26,199	.0
Average.....	2,766	73	73	146				2,620	.0
Second subperiod:									
Total.....	27,719	646	651	1,297	2.33	2.35	4.68	26,422	.0
Average.....	2,772	65	65	130				2,642	.0
Entire after period:									
Total.....	55,375	1,377	1,377	2,754	2.49	2.48	4.97	52,621	.0
Average.....	2,769	69	69	138				2,631	.0

TABLE XVI.—*Calories balances for Series VIII—Continued.*

## SUMMARIES—Continued.

[Averages are per man per day.]

Nos. 1, 2, 4, 5, and 6.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Balance (1-4).	9 Ben- zoic acid admin- istered.
<i>Fore period.</i>									
First subperiod:	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Calories.</i>	<i>Grams.</i>
Total.....	71,971	2,208	1,694	3,902	3.07	2.35	5.42	68,069	0.0
Average.....	2,879	88	68	156				2,723	.0
Second subperiod:									
Total.....	72,798	2,444	1,909	4,353	3.36	2.62	5.98	68,445	.0
Average.....	2,912	98	76	174				2,738	.0
Entire fore period:									
Total.....	144,769	4,652	3,603	8,255	3.21	2.49	5.70	136,514	.0
Average.....	2,895	93	72	165				2,730	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	72,372	2,583	1,869	4,452	3.57	2.58	6.15	67,920	25.00
Average.....	2,895	103	75	178				2,717	1.00
Second subperiod:									
Total.....	70,792	2,175	1,840	4,015	3.07	2.60	5.67	66,777	37.50
Average.....	2,832	87	74	161				2,671	1.50
Third subperiod:									
Total.....	70,566	2,501	1,888	4,389	3.54	2.68	6.22	66,177	48.00
Average.....	2,823	100	76	176				2,647	1.92
First, second, and third sub- periods:									
Total.....	213,730	7,259	5,597	12,856	3.40	2.62	6.02	200,874	110.50
Average.....	2,850	97	75	172				2,678	1.47
<i>After period.</i>									
First subperiod:									
Total.....	69,526	2,564	1,812	4,376	3.60	2.60	6.29	65,150	.0
Average.....	2,781	103	72	175				2,606	.0
Second subperiod:									
Total.....	69,865	1,896	1,693	3,589	2.75	2.42	5.17	66,276	.0
Average.....	2,795	76	68	144				2,651	.0
Entire after period:									
Total.....	139,391	4,460	3,505	7,965	3.24	2.52	5.76	131,426	.0
Average.....	2,788	89	70	159				2,629	.0



TABLE XVI.—*Calories balances for Series VIII—Continued.*

## SUMMARIES—Continued.

[Averages are per man per day.]

Nos. 7 to 12.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Balance (1-4).	9 Sodium ben- zoate admin- istered (calcu- lated as benzoic acid).
<i>Fore period.</i>	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Calo- ries.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Calories.</i>	<i>Grams.</i>
First subperiod:									
Total.....	89,826	3,065	2,112	5,177	3.41	2.35	5.76	84,649	.0
Average.....	2,994	102	70	172				2,822	.0
Second subperiod:									
Total.....	92,771	2,272	2,173	4,445	2.45	2.34	4.79	88,326	.0
Average.....	3,092	76	72	148				2,944	.0
Entire fore period:									
Total.....	182,597	5,337	4,285	9,622	2.92	2.35	5.27	172,975	.0
Average.....	3,043	89	71	160				2,883	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	91,536	2,528	2,367	4,895	2.76	2.58	5.34	86,641	29.40
Average.....	3,051	84	79	163				2,888	.98
Second subperiod:									
Total.....	89,720	3,229	2,167	5,396	3.60	2.41	6.01	84,324	45.00
Average.....	2,990	108	72	180				2,810	1.50
Third subperiod:									
Total.....	88,810	2,247	2,250	4,497	2.53	2.53	5.06	84,313	58.00
Average.....	2,960	75	75	150				2,810	1.93
First, second, and third subperiods:									
Total.....	270,066	8,004	6,784	14,788	2.96	2.51	5.48	255,278	132.40
Average.....	3,001	89	75	164				2,837	1.47
<i>After period.</i>									
First subperiod:									
Total.....	88,771	2,988	1,985	4,973	3.36	2.23	5.59	83,798	.0
Average.....	2,959	100	66	166				2,793	.0
Second subperiod:									
Total.....	84,639	3,248	2,129	5,377	3.84	2.51	6.35	79,262	.0
Average.....	2,821	108	71	179				2,642	.0
Entire after period:									
Total.....	173,410	6,236	4,114	10,350	3.60	2.37	5.97	163,060	.0
Average.....	2,890	104	68	172				2,718	.0

TABLE XVI.—*Calories balances for Series VIII—Continued.*

## SUMMARIES—Continued.

[Averages are per man per day.]

## Summary for Nos. 1 to 12, omitting No. 3.

Period.	1	2	3	4	5	6	7	8	9
	In food.	In feces.	In urine.	In feces and urine (2+3).	In feces (2÷1).	In urine (3÷1).	In feces and urine (4÷1).	Balance (1-4).	Preservative administered (calculated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Calo-ries.</i>	<i>Calo-ries.</i>	<i>Calo-ries.</i>	<i>Calo-ries.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Calories.</i>	<i>Grams.</i>
Total.....	161,797	5,273	3,806	9,079	3.26	2.35	5.61	152,718	0.0
Average.....	2,942	96	69	165				2,777	.0
Second subperiod:									
Total.....	165,569	4,716	4,082	8,798	2.85	2.47	5.31	156,771	.0
Average.....	3,010	86	74	160				2,850	.0
Entire fore period:									
Total.....	327,366	9,989	7,888	17,877	3.05	2.41	5.46	309,489	.0
Average.....	2,976	91	72	163				2,813	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	163,908	5,111	4,236	9,347	5.12	2.58	5.70	154,561	54.40
Average.....	2,980	93	77	170				2,810	.99
Second subperiod:									
Total.....	160,512	5,404	4,007	9,411	3.37	2.50	5.86	151,101	82.50
Average.....	2,918	98	73	171				2,747	1.50
Third subperiod:									
Total.....	159,376	4,748	4,138	8,886	2.98	2.60	5.58	150,490	106.00
Average.....	2,898	86	75	161				2,737	1.93
First, second, and third subperiods:									
Total.....	483,796	15,263	12,381	27,644	3.15	2.56	5.71	456,152	242.90
Average.....	2,932	93	75	168				2,764	1.47
<i>After period.</i>									
First subperiod:									
Total.....	158,297	5,552	3,797	9,349	3.51	2.40	5.91	148,948	.0
Average.....	2,878	101	69	170				2,708	.0
Second subperiod:									
Total.....	154,504	5,144	3,822	8,966	3.37	2.48	5.85	145,538	.0
Average.....	2,809	94	69	163				2,646	.0
Entire after period:									
Total.....	312,801	10,696	7,619	18,315	3.44	2.44	5.88	294,486	.0
Average.....	2,844	97	69	167				2,677	.0

## SOLIDS BALANCE.

The influence of the benzoic acid and benzoate of soda upon the excretion of the solids is a matter of only incidental importance in so far as it bears upon the metabolism of the different elements entering into the food.

## INDIVIDUAL DATA.

## No. 1.

The data for No. 1 show virtually no change in the excretion of the solids in the preservative period except that they are increased slightly in the feces during the after period and decreased in the

urine, with a resulting decrease in total elimination of 4 grams daily. The percentage data show practically the same relations and both balances and amounts ingested decrease slightly throughout.

*No. 2.*

In the case of No. 2, the solids in the feces are increased in the preservative period and this increase is continued, though not to the same degree, in the after period. The same changes take place in the solids excreted in the urine. The total solids, therefore, in both feces and urine are considerably greater in the preservative period than in the fore period (10 grams daily), while in the after period the increase is only 4 grams as compared with the fore period. This increased excretion takes place notwithstanding the slight continuous decrease in solids ingested, amounting to 8 and 17 grams daily in the preservative and after periods, respectively.

*No. 3.*

In the case of No. 3 there is also a slight increase in the solids excreted in the feces in the preservative period and the amount in the after period is less than in the fore period. The solids of the urine remain practically unchanged. Little effect is noticed in this case upon the excretion of total solids, the percentage data showing an increase in total elimination of only 1.05 per cent with a decrease of 2.05 per cent in the after period as compared with the preservative period.

*No. 4.*

In the case of No. 4, there is practically no effect produced upon the excretion of the solids either in the feces or in the urine, as is shown by both the actual quantities and the percentage data, the figures being remarkably constant throughout.

*No. 5.*

The data for No. 5 show a slight increase in the solids excreted in the preservative period both in the feces and in the urine and the decrease in the balance (4 grams daily), is accompanied by an increased ingestion of 4 grams. In the after period there is a uniform tendency to resume the conditions of the fore period.

*No. 6.*

The data for No. 6 show a decrease in the solids excreted in the feces of 5 grams daily and no change in the solids in the urine in the preservative period. In the after period there is a decrease in both cases. The percentage figures show that there is practically no change in total elimination until the after period when a slight

decrease takes place. The decrease in the balance of 16 grams is accompanied by a decrease in ingestion of 20 grams in the preservative period; the ingestion in the after period is almost the same, but the balance increases 10 grams as compared with the preservative period.

*No. 7.*

In the case of No. 7 it is seen that there is a slight decrease in the solids both in the feces and the urine during the preservative period, the total decrease amounting to only 2 grams per day; in the after period the decrease is again 2 grams, due to a large decrease in the metabolized solids, the nonmetabolized solids being increased 5 grams. The percentage data show practically no change in the preservative period and an increase of 1.25 per cent in the after period.

*No. 8.*

In the case of No. 8 there is an increase in the solids both in the feces and urine during the preservative period, the total amounting to 8 grams daily, while the amount ingested decreases 8 grams. In the after period the excretion decreases 2 grams, while the amount ingested increases 6 grams. The percentage data show an increase of 1.44 per cent in total excretion in the preservative period followed by a very slight decrease not returning to the figures of the fore period. The balance decreases 16 grams in the preservative period and 8 grams in the after period as compared with the fore period, accompanied by a decrease of 8 and 2 grams, respectively, in ingestion. These data would indicate a considerable decrease in the assimilation of solids.

*No. 9.*

In the case of No. 9 there is a decrease of 5 grams daily in the solids during the preservative period in the feces and a slight increase (2 grams) in the solids in the urine. The total percentage decrease in elimination is very slight, about 0.4 per cent. The balance in the preservative period decreases 10 grams daily, but the amount ingested decreases 14 grams. In the after period there is a further decrease of 2 grams in the amount of solids ingested, while the balance further decreases 12 grams. In this case there is practically no effect produced which can be attributed to the preservative, though there is a slight tendency to increase assimilation in the preservative period.

*No. 10.*

In the case of No. 10 there is little difference in the quantity of solids in the feces and urine in the fore and preservative periods, but the very slight tendency to increase excretion is accompanied by a decrease in ingestion of 46 grams per day. The total increase in



excretion is 3 grams, or 1.52 per cent. The balance decreases 49 grams, 3 grams more than the decrease in ingestion. In the after period there is a continued increase in total excretion amounting to 4 grams, but the amount of solids ingested increases 21 grams. The percentage data, therefore, express the correct relation, and they show practically no change in the after period as compared with the preservative period. The balance increases 17 grams as compared with the preservative period, but the amount ingested, as before stated, increases 21 grams. There would seem to be in this case a slight tendency to decrease the assimilation of solids under the influence of the preservative.

*No. 11.*

In the case of No. 11 there is a notable increase in the solids both in the feces and in the urine during the preservative period, the total increase averaging 11 grams daily, a percentage increase of 1.85. In the after period the excretion is less than in the preservative period, but does not quite return to the figure of the fore period. The balance decreases in the preservative period 13 grams daily, while the amount of solids ingested is almost unchanged, decreasing only 2 grams. In the after period the average daily balance increases 23 grams, as compared with the preservative period, and the amount ingested increases 16 grams. There is again a slight tendency shown to decrease the assimilation of the total solids in the preservative period.

*No. 12.*

In the case of No. 12 there is a slight decrease in the solids in the feces and an increase in the solids in the urine in the preservative period, the effect on total excretion being an average increase of 5 grams daily, representing a percentage increase of 1.07. In the after period the total solids excreted decrease 10 grams, reaching a figure less than in the fore period, though the percentage of excretion is about the same. The balance decreases 25 grams daily in the preservative period, while the amount ingested decreased 20 grams; in the after period, there is a further decrease of 17 grams, the amount of solids ingested, however, decreasing 27 grams. There is again a slight tendency to decrease the assimilation of solids in the preservative period.

SUMMARIES.

The summary for Nos. 1 and 4 is of interest chiefly because they completed the entire observation covering a preservative period of twenty days. This summary shows practically no effect upon the metabolism of the solids as a whole. The actual amounts excreted in the three periods are virtually the same, decreasing 1 and 3 grams in the preservative and after periods, respectively, as compared with

the fore period, while the amounts ingested decrease 13 and 23 grams, respectively. The percentage data accordingly show a very slight increase in the preservative period, and this is maintained in the after period. The balance decreases 12 and 20 grams in the preservative and after periods, as compared with the fore period, being slightly less than the decreases in ingestion. The tendency to decrease assimilation in this case is so slight as to be purely theoretical, and no conclusion could be based upon these figures alone. It was to be expected that these subjects would show less effect from the preservative inasmuch as they showed a greater ability to tolerate it than the other subjects. For Nos. 1, 2, 4, 5, and 6, and Nos. 7 to 12, inclusive, both excluding the fourth preservative subperiod, and the combined data for the eleven men, including all but No. 3, for the same period, gives the final survey of these data in comparable form.

The summary in the case of the five men receiving benzoic acid show almost no change in the solids in the feces during the three periods. There is, however, an average increase of 1 gram daily accompanied by a decreased average ingestion of 5 grams. There is a slight increase in the solids in the urine during the preservative period, amounting to 3 grams daily. Expressed in percentages it is seen that of the solids ingested 3.18 per cent appears in the feces in the fore period, 3.40 per cent in the preservative period, and 3.23 per cent in the after period. This shows a very slight tendency on the part of the preservative as benzoic acid to increase the quantity of solids in the feces. In the urine there appears in the fore period 9.89 per cent of the solids ingested, 10.38 per cent in the preservative period, and 9.96 per cent in the after period, showing a slight tendency on the part of the benzoic acid to increase the solids in the urine also. This may be influenced to some extent by the increase in the hippuric acid in the urine and the benzoic acid excreted as such. The total excretion is increased only 0.71 per cent in the preservative period and decreases very slightly in the after period. The balance decreases throughout and to a slightly greater extent than the amount ingested in the preservative period. In this case there is a slight tendency to decrease the assimilation of the total solids.

In the case of Nos. 7 to 12, inclusive, there is no change in the quantity of solids in the feces in the preservative period and a slight increase in the after period. In the urine there is a slight increase in the solids in the preservative period and a decrease in the after period. The amounts of solids ingested decrease 8 grams in the preservative period and 17 grams more in the after period. Expressed as percentages of the amounts ingested, 3.05 per cent of solids appear in the feces in the fore period, 3.11 per cent in the preservative period, and 3.69 per cent in the after period, a slight increase throughout. In the case of the solids appearing in the urine

9.98 per cent occur in the fore period, 10.84 per cent in the preservative period, and 10.31 per cent in the after period, again an increase in the preservative period, but a slight decrease in the after period. The increase in total excretion in the preservative period is 0.92 per cent, with practically no change in the after period. The balance decreases 12 grams and again 15 grams in the preservative and after periods, respectively, as compared with a decrease of 8 and 17 grams in ingestion. These data, therefore, uniformly indicate a very slight decrease in the assimilation of total solids.

In the total effect produced in the case of the eleven men it is seen that there is a slight increase in the quantity of solids excreted in the feces in the preservative period, and this is maintained in the after period. There is also a slight increase in the quantity of solids excreted in the urine in the preservative period, but this increase is lost in the after period. The increase in total elimination amounts to 4 grams daily in the preservative period, while the figure for the after period is exactly the same as in the fore period. Expressed as percentages, it is seen that of the total solids in the food 3.11 per cent is excreted in the fore period, in the preservative period 3.24 per cent, and in the after period 3.49 per cent, a slight increase throughout. Of the total solids ingested there appears in the urine in the fore period 9.94 per cent, in the preservative period 10.63 per cent, and in the after period 10.16 per cent, again a slight increase in the preservative period, but a practical return to the condition of the fore period in the after period. The balance is decreased 11 grams daily in the preservative period, while the ingestion decreases only 7 grams; in the after period there is a further decrease of 10 grams, but a decrease in amount ingested of 14 grams, indicating a tendency to increase assimilation on the withdrawal of the preservative.

We may, therefore, infer that there is a very slight effect produced as a whole by the benzoic acid and the benzoate of-soda in increasing the quantity of solids excreted in the feces and in the urine, as shown by the figures giving actual amounts and by the decrease in balance as well as by the percentage figures. This effect, however, is of no practical magnitude and can only be regarded as showing a uniform tendency on the part of the preservative to disturb the metabolic processes.



TABLE XVII.—*Solids balances for Series VIII.*

[Averages are per day.]

No. 1.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Balance (1-4).	9 Ben- zoic acid ad- minis- tered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	2,980	42	298	340	1.41	10.10	11.40	2,640	0.0
Average.....	596	8	60	68				528	.0
Second subperiod:									
Total.....	3,076	64	312	376	2.08	10.14	12.22	2,700	.0
Average.....	615	13	62	75				540	.0
Entire fore period:									
Total.....	6,056	106	610	716	1.75	10.07	11.82	5,340	.0
Average.....	606	11	61	72				534	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	2,957	61	305	366	2.06	10.31	12.37	2,591	5.00
Average.....	591	12	61	73				518	1.00
Second subperiod:									
Total.....	2,953	42	309	351	1.42	10.46	11.89	2,602	7.50
Average.....	591	8	62	70				520	1.50
Third subperiod:									
Total.....	2,908	66	302	368	2.27	10.39	12.65	2,540	10.00
Average.....	582	13	60	74				508	2.00
Fourth subperiod:									
Total.....	2,976	40	314	354	1.34	10.55	11.90	2,622	12.50
Average.....	595	8	63	71				524	2.50
Entire preservative period:									
Total.....	11,794	209	1,230	1,439	1.77	10.43	12.20	10,355	35.00
Average.....	590	10	62	72				518	1.75
<i>After period.</i>									
First subperiod:									
Total.....	2,860	64	289	353	2.24	10.10	12.34	2,507	.0
Average.....	572	13	58	71				501	.0
Second subperiod:									
Total.....	2,813	62	270	332	2.20	9.60	11.80	2,481	.0
Average.....	563	12	54	66				497	.0
Entire after period:									
Total.....	5,673	126	559	685	2.22	9.85	12.07	4,988	.0
Average.....	567	13	56	68				499	.0



TABLE XVII.—*Solids balances for Series VIII—Continued.*

[Averages are per day.]

## No. 2.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Bal- ance. (1-4)	9 Ben- zoic acid ad- minis- tered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	3,255	104	327	431	3.20	10.05	13.24	2,824	0.0
Average.....	651	21	65	86				565	.0
Second subperiod:									
Total.....	3,335	126	375	501	3.78	11.24	15.02	2,834	.0
Average.....	667	25	75	100				567	.0
Entire fore period:									
Total.....	6,590	230	702	932	3.49	10.65	14.14	5,658	.0
Average.....	659	23	70	93				566	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	3,294	137	369	506	4.16	11.20	15.36	2,788	5.00
Average.....	659	27	74	101				558	1.00
Second subperiod:									
Total.....	3,250	144	385	529	4.43	11.85	16.28	2,721	7.50
Average.....	650	29	77	106				544	1.50
Third subperiod:									
Total.....	3,309	150	382	532	4.37	11.53	15.90	2,777	10.00
Average.....	662	30	76	106				556	2.00
Fourth subperiod:									
Total.....	3,165	136	356	492	4.30	11.25	15.55	2,673	2.50
Average.....	633	27	71	98				535	.50
Entire preservative period:									
Total.....	13,018	567	1,492	2,059	4.35	11.46	15.82	10,959	25.00
Average.....	651	28	75	103				548	1.25
<i>After period.</i>									
First subperiod:									
Total.....	3,167	137	357	494	4.33	11.27	15.60	2,673	.0
Average.....	633	27	71	99				534	.0
Second subperiod:									
Total.....	3,168	121	351	472	3.82	11.08	14.90	2,696	.0
Average.....	634	24	70	94				540	.0
Entire after period:									
Total.....	6,335	858	708	966	4.07	11.18	15.25	5,369	.0
Average.....	634	26	71	97				537	.0

TABLE XVII.—*Solids balances for Series VIII—Continued.*

[Averages are per day.]

No. 3.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Bal- ance (1-4).	9 Ben- zoic acid ad- minis- tered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	3,225	91	288	379	2.82	8.93	11.75	2,846	0.0
Average.....	645	18	58	76				569	.0
Second subperiod:									
Total.....	3,257	93	306	399	2.86	9.40	12.25	2,858	.0
Average.....	651	19	61	80				571	.0
Entire fore period:									
Total.....	6,482	184	594	778	2.84	9.16	12.00	5,704	.0
Average.....	648	18	59	78				570	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	3,300	112	303	415	3.39	9.18	12.58	2,885	5.00
Average.....	660	22	61	83				577	1.00
Second subperiod:									
Total.....	3,301	127	346	473	3.85	10.48	14.33	2,828	7.50
Average.....	660	25	69	95				565	1.50
Third subperiod:									
Total.....	2,483	52	258	310	2.09	10.39	12.48	2,173	1.00
Average.....	497	10	52	62				435	.20
Fourth subperiod:									
Total.....	3,183	124	279	403	3.00	8.77	12.66	2,780	.0
Average.....	637	25	56	81				556	.0
Entire preservative period:									
Total.....	12,267	415	1,186	1,601	3.38	9.67	13.05	10,666	13.50
Average.....	613	21	59	80				533	.68
<i>After period.</i>									
First subperiod:									
Total.....	3,362	75	306	381	2.23	9.10	11.33	2,981	.0
Average.....	672	15	61	76				596	.0
Second subperiod:									
Total.....	3,295	73	278	351	2.22	8.44	10.65	2,944	.0
Average.....	659	15	56	70				589	.0
Entire after period:									
Total.....	6,657	148	584	732	2.22	8.77	11.00	5,925	.0
Average.....	666	15	58	73				593	.0

TABLE XVII.—*Solids balances for Series VIII—Continued.*

[Averages are per day.]

## No. 4.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Bal- ance (1-4).	9 Ben- zoic acid ad- minis- tered.
<i>Fore period.</i>									
First subperiod	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	2,654	83	261	344	3.13	9.83	12.96	2,310	0.0
Average.....	531	17	52	69				462	.0
Second subperiod:									
Total.....	2,578	67	268	335	2.60	10.40	12.99	2,243	.0
Average.....	516	13	54	67				449	.0
Entire fore period:									
Total.....	5,232	150	529	679	2.87	10.11	12.98	4,553	.0
Average.....	523	15	53	68				455	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	2,610	76	255	331	2.91	9.77	12.68	2,279	5.00
Average.....	522	15	51	66				456	1.00
Second subperiod:									
Total.....	2,569	68	261	329	2.65	10.16	12.81	2,240	7.50
Average.....	514	14	52	66				448	1.50
Third subperiod:									
Total.....	2,596	68	260	328	2.62	10.02	12.63	2,268	10.00
Average.....	519	14	52	66				453	2.00
Fourth subperiod:									
Total.....	2,515	74	258	332	2.94	10.26	13.20	2,183	12.50
Average.....	503	15	52	66				437	2.50
Entire preservative period:									
Total.....	10,290	286	1,034	1,320	2.78	10.05	12.82	8,970	35.00
Average.....	514	14	52	66				448	1.75
<i>After period.</i>									
First subperiod:									
Total.....	2,560	79	288	367	3.09	11.25	14.34	2,193	.0
Average.....	512	16	58	73				439	.0
Second subperiod:									
Total.....	2,615	62	240	302	2.37	9.18	11.55	2,313	.0
Average.....	523	12	48	60				463	.0
Entire after period:									
Total.....	5,175	141	528	669	2.72	10.20	12.93	4,506	.0
Average.....	518	14	53	67				451	.0

TABLE XVII.—*Solids balances for Series VIII*—Continued.

[Averages are per day.]

No. 5.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Bal- ance (1-4).	9 Ben- zoic acid ad- minis- tered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	2,363	46	a 210	256	1.95	8.89	10.83	2,107	0.0
Average.....	473	9	42	51				422	.0
Second subperiod:									
Total.....	2,486	78	205	283	3.14	8.25	11.38	2,203	.0
Average.....	497	16	41	57				440	.0
Entire fore period:									
Total.....	4,849	124	415	539	2.56	8.56	11.12	4,310	.0
Average.....	485	12	42	54				431	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	2,451	87	220	307	3.55	8.98	12.53	2,144	5.00
Average.....	490	17	44	61				429	1.00
Second subperiod:									
Total.....	2,505	72	a 246	318	2.87	9.82	12.69	2,187	7.50
Average.....	501	14	49	64				437	1.50
Third subperiod:									
Total.....	2,435	75	241	316	3.08	9.90	12.98	2,119	8.00
Average.....	487	15	48	63				424	1.60
Fourth subperiod:									
Total.....	2,397	94	a 202	296	3.02	8.43	12.35	2,101	3.00
Average.....	479	19	40	59				420	.60
Entire preservative period:									
Total.....	9,788	328	909	1,237	3.35	9.29	12.64	8,551	23.50
Average.....	489	16	45	62				427	1.18
<i>After period.</i>									
First subperiod:									
Total.....	2,462	17	a 222	319	3.94	9.02	12.96	2,143	.0
Average.....	492	19	44	64				428	.0
Second subperiod:									
Total.....	2,495	61	202	263	2.44	8.10	10.54	2,232	.0
Average.....	499	12	40	53				446	.0
Entire after period:									
Total.....	4,957	158	424	582	3.19	8.55	11.74	4,375	.0
Average.....	496	16	42	58				438	.0

a Daily average added to complete record.



TABLE XVII.—*Solids balances for Series VIII—Continued.*

[Averages are per day.]

No. 6.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Bal- ance (1-4).	9 Ben- zoic acid ad- minis- tered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	2,880	162	289	451	5.62	10.03	15.66	2,429	0.0
Average.....	576	32	58	90	.....	.....	.....	486	.0
Second subperiod:									
Total.....	2,888	135	273	408	4.67	9.45	14.13	2,480	.0
Average.....	578	27	55	82	.....	.....	.....	496	.0
Entire fore period:									
Total.....	5,768	297	562	859	5.15	9.74	14.89	4,909	.0
Average.....	577	30	56	86	.....	.....	.....	491	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	2,938	147	282	429	5.00	9.60	14.60	2,509	5.00
Average.....	588	29	56	86	.....	.....	.....	502	1.00
Second subperiod:									
Total.....	2,767	110	289	399	3.98	10.44	14.42	2,368	7.50
Average.....	553	22	58	80	.....	.....	.....	473	1.50
Third subperiod:									
Total.....	2,743	134	282	416	4.89	10.28	15.17	2,327	10.00
Average.....	549	27	56	83	.....	.....	.....	466	2.00
Fourth subperiod:									
Total.....	2,695	114	273	387	4.23	10.13	14.36	2,308	.0
Average.....	539	23	55	77	.....	.....	.....	462	.0
Entire preservative period:									
Total.....	11,143	505	1,126	1,631	4.53	10.10	14.64	9,512	22.50
Average.....	557	25	56	82	.....	.....	.....	475	1.13
<i>After period.</i>									
First subperiod:									
Total.....	2,769	136	279	415	4.91	10.08	14.99	2,354	.0
Average.....	554	27	56	83	.....	.....	.....	471	.0
Second subperiod:									
Total.....	<sup>a</sup> 2,814	<sup>a</sup> 66	<sup>a</sup> 255	<sup>a</sup> 321	2.35	9.06	11.41	2,493	.0
Average.....	563	13	51	64	.....	.....	.....	499	.0
Entire after period:									
Total.....	5,583	202	534	736	3.62	9.56	13.18	4,847	.0
Average.....	558	20	53	73	.....	.....	.....	485	.0

<sup>a</sup> Daily average added to complete record.

TABLE XVII.—*Solids balances for Series VIII*—Continued.

[Averages are per day.]

No. 7.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Bal- ance (1-4).	9 Sodium ben- zoate admin- istered (calcu- lated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	2,530	93	271	364	3.68	10.71	14.39	2,166	0.0
Average.....	506	19	54	73				433	.0
Second subperiod:									
Total.....	2,672	88	282	370	3.29	10.55	13.85	2,302	.0
Average.....	534	18	56	74				460	.0
Entire fore period:									
Total.....	5,202	181	553	734	3.48	10.63	14.11	4,468	.0
Average.....	520	18	55	73				447	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	2,463	78	270	348	3.17	10.96	14.13	2,115	4.90
Average.....	493	16	54	70				423	.98
Second subperiod:									
Total.....	2,591	105	275	380	4.05	10.61	14.67	2,211	7.50
Average.....	518	21	55	76				442	1.50
Third subperiod:									
Total.....	2,619	72	262	334	2.75	10.00	12.75	2,285	10.00
Average.....	524	14	52	67				457	2.00
Fourth subperiod:									
Total.....	2,290	73	277	350	3.19	12.10	15.28	1,940	6.50
Average.....	458	15	55	70				388	1.50
Entire preservative period:									
Total.....	9,963	326	1,084	1,412	3.29	10.88	14.17	8,551	28.90
Average.....	498	16	54	71				427	1.45
<i>After period.</i>									
First subperiod:									
Total.....	2,387	95	237	332	3.98	9.93	13.91	2,055	.0
Average.....	477	19	47	66				411	.0
Second subperiod:									
Total.....	2,075	117	239	356	5.64	11.52	17.16	1,719	.0
Average.....	415	23	48	71				344	.0
Entire after period:									
Total.....	4,462	212	476	688	4.75	10.67	15.42	3,774	.0
Average.....	446	21	48	69				377	.0

TABLE XVII.—*Solids balances for Series VIII*—Continued.

[Averages are per day.]

No. 8.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Bal- ance (1-4).	9 Sodium ben- zoate admin- istered (calcu- lated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	2,843	126	290	416	4.43	10.20	14.63	2,427	0.0
Average.....	569	25	58	83				486	.0
Second subperiod:									
Total.....	2,935	49	280	329	1.67	9.54	11.21	2,606	.0
Average.....	587	10	56	66				521	.0
Entire fore period:									
Total.....	5,778	175	570	745	3.02	9.86	12.89	5,033	.0
Average.....	578	18	57	74				504	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	2,933	112	303	415	3.82	10.33	14.15	2,518	4.90
Average.....	587	22	61	83				504	.98
Second subperiod:									
Total.....	2,820	100	<sup>a</sup> 306	406	3.55	10.85	14.40	2,414	7.50
Average.....	564	20	61	81				483	1.50
Third subperiod:									
Total.....	2,840	99	308	407	3.49	10.85	14.33	2,433	10.00
Average.....	568	20	62	81				487	2.00
Fourth subperiod:									
Total.....	2,806	105	300	405	3.74	10.69	14.43	2,401	12.50
Average.....	561	21	60	81				480	2.50
Entire preservative period:									
Total.....	11,399	416	1,217	1,633	3.65	10.68	14.33	9,766	34.90
Average.....	570	21	61	82				488	1.75
<i>After period.</i>									
First subperiod:									
Total.....	2,907	109	304	413	3.75	10.46	14.21	2,494	.0
Average.....	581	22	61	83				498	.0
Second subperiod:									
Total.....	2,858	117	275	392	4.09	9.62	13.72	2,466	.0
Average.....	572	23	55	78				494	.0
Entire after period:									
Total.....	5,765	226	579	805	3.92	10.04	13.96	4,960	.0
Average.....	576	23	58	80				496	.0

<sup>a</sup> Average added to complete period.

TABLE XVII.—*Solids balances for Series VIII—Continued.*

[Averages are per day.]

## No. 9.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Balance (1-4).	9 Sodium benzo- ate ad- minis- tered (calcu- lated as ben- zoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	2,615	92	<sup>a</sup> 338	430	3.32	12.93	16.44	2,185	0.0
Average.....	523	18	68	86	.....	.....	.....	437	.0
Second subperiod:									
Total.....	2,596	81	307	388	3.12	11.83	14.95	2,208	.0
Average.....	519	16	61	78	.....	.....	.....	441	.0
Entire fore period:									
Total.....	5,211	173	645	818	3.32	12.38	15.70	4,393	.0
Average.....	521	17	64	82	.....	.....	.....	439	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	2,566	47	<sup>a</sup> 328	375	1.83	12.78	14.61	2,191	4.90
Average.....	513	9	66	75	.....	.....	.....	438	.98
Second subperiod:									
Total.....	2,536	91	305	396	3.59	12.03	15.62	2,140	7.50
Average.....	507	18	61	79	.....	.....	.....	428	1.50
Third subperiod:									
Total.....	2,502	39	354	393	1.56	14.15	15.71	2,109	10.00
Average.....	500	8	71	79	.....	.....	.....	421	2.00
First, second, and third sub- periods:									
Total.....	7,604	177	987	1,164	2.33	12.98	15.31	6,440	22.40
Average.....	507	12	66	78	.....	.....	.....	429	<sup>b</sup> 1.12
<i>After period.</i>									
First subperiod:									
Total.....	2,547	84	337	421	3.30	13.23	16.53	2,126	.0
Average.....	509	17	67	84	.....	.....	.....	425	.0
Second subperiod:									
Total.....	2,502	122	342	464	4.88	13.67	18.55	2,038	.0
Average.....	500	24	68	93	.....	.....	.....	407	.0
Entire after period:									
Total.....	5,049	206	679	885	4.08	13.45	17.53	4,164	.0
Average.....	505	21	68	88	.....	.....	.....	417	.0

<sup>a</sup> Average added to complete period.<sup>b</sup> Average for 20 days.



TABLE XVII.—*Solids balances for Series VIII—Continued.*

[Averages are per day.]

## No. 10.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Balance (1-4).	9 Sodium benzoate administered (calculated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	2,808	96	246	342	3.42	8.76	12.18	2,466	0.0
Average.....	562	19	49	68				494	.0
Second subperiod:									
Total.....	3,018	51	250	301	1.69	8.28	9.97	2,717	.0
Average.....	604	10	50	60				544	.0
Entire fore period:									
Total.....	5,826	147	496	643	2.52	8.51	11.04	5,183	.0
Average.....	583	15	50	64				519	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	2,803	48	283	331	1.71	10.10	11.81	2,472	4.90
Average.....	561	10	57	66				495	.98
Second subperiod:									
Total.....	2,844	142	<sup>a</sup> 282	424	4.99	9.92	14.91	2,420	7.50
Average.....	569	28	56	85				484	1.50
Third subperiod:									
Total.....	2,647	72	240	312	2.72	9.07	11.79	2,335	8.00
Average.....	529	14	48	62				467	1.60
Fourth subperiod:									
Total.....	2,446	64	<sup>a</sup> 218	282	2.62	8.91	11.53	2,164	.0
Average.....	489	13	42	56				433	.0
Entire preservative period:									
Total.....	10,740	326	1,023	1,349	3.04	9.53	12.56	9,391	20.40
Average.....	537	16	51	67				470	1.02
<i>After period.</i>									
First subperiod:									
Total.....	2,858	94	275	369	3.29	9.62	12.91	2,489	.0
Average.....	572	19	55	74				498	.0
Second subperiod:									
Total.....	2,717	94	246	340	3.46	9.05	12.51	2,377	.0
Average.....	543	19	49	68				475	.0
Entire after period:									
Total.....	5,575	188	521	709	3.37	9.35	12.72	4,866	0
Average.....	558	19	52	71				487	0

<sup>a</sup> Average added to complete period.

TABLE XVII.—*Solids balances for Series VIII—Continued.*

[Averages are per day.]

No. 11.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Bal- ance (1-4).	9 Sodium ben- zoate admin- istered (calcu- lated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	3,092	75	333	408	2.43	10.77	13.20	2,684	0.0
Average.....	618	15	67	82				536	.0
Second subperiod:									
Total.....	3,295	84	297	381	2.55	9.01	11.56	2,914	.0
Average.....	659	17	59	76				583	.0
Entire fore period:									
Total.....	6,387	159	630	789	2.49	9.86	12.35	5,598	.0
Average.....	639	16	63	79				560	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	3,319	124	355	479	3.74	10.70	14.43	2,840	4.90
Average.....	664	25	71	96				568	.98
Second subperiod:									
Total.....	3,201	112	331	443	3.50	10.34	13.84	2,758	7.50
Average.....	640	22	66	89				551	1.50
Third subperiod:									
Total.....	3,263	72	377	449	2.21	11.56	13.76	2,814	10.00
Average.....	653	14	75	90				563	2.00
Fourth subperiod:									
Total.....	2,948	100	337	437	3.39	11.43	14.82	2,511	2.50
Average.....	590	20	67	87				503	.50
Entire preservative period:									
Total.....	12,731	408	1,400	1,808	3.20	11.00	14.20	10,923	24.90
Average.....	637	20	70	90				547	1.25
<i>After period.</i>									
First subperiod:									
Total.....	3,305	106	318	424	3.21	9.62	12.83	2,881	.0
Average.....	661	21	64	85				576	.0
Second subperiod:									
Total.....	3,226	97	306	403	3.01	9.40	12.50	2,823	.0
Average.....	645	19	61	81				564	.0
Entire after period:									
Total.....	6,531	203	624	827	3.11	9.55	12.66	5,704	.0
Average.....	653	20	62	83				570	.0

TABLE XVII.—*Solids balances for Series VIII—Continued.*

[Averages are per day.]

No. 12.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Balance (1-4).	9 Sodium benzoate administered (calculated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	3,382	130	311	441	3.84	9.20	13.04	2,941	0.0
Average.....	676	26	62	88				588	.0
Second subperiod:									
Total.....	701	23	63	86	3.23	9.02	12.25	615	.0
Average.....	3,503	113	316	429				3,074	.0
Entire fore period:									
Total.....	6,885	243	627	870	3.53	9.11	12.64	6,015	.0
Average.....	688	24	63	87				601	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	3,486	115	364	479	3.29	10.44	13.74	3,007	4.90
Average.....	697	23	73	96				601	.98
Second subperiod:									
Total.....	3,432	98	360	458	2.86	10.49	13.34	2,974	7.50
Average.....	686	20	72	92				594	1.50
Third subperiod:									
Total.....	3,329	95	356	451	2.85	10.69	13.55	2,878	10.00
Average.....	666	19	71	90				576	2.00
Fourth subperiod:									
Total.....	3,104	139	304	443	4.48	9.79	14.27	2,661	.0
Average.....	621	28	61	89				532	.0
Entire preservative period:									
Total.....	13,351	447	1,384	1,831	3.35	10.37	13.71	11,520	22.40
Average.....	668	22	69	92				576	1.12
<i>After period.</i>									
First subperiod:									
Total.....	3,262	103	326	429	3.16	9.99	13.15	2,833	.0
Average.....	652	21	65	86				566	.0
Second subperiod:									
Total.....	3,144	108	280	388	3.44	8.91	12.34	2,756	.0
Average.....	629	22	56	78				551	.0
Entire after period:									
Total.....	6,406	211	606	817	3.29	9.46	12.75	5,589	0
Average.....	641	21	61	82				559	.0

TABLE XVII.—*Solids balances for Series VIII*—Continued.

## SUMMARIES.

[Averages are per man per day.]

Nos. 1 and 4.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2+1).	6 In urine (3+1).	7 In feces and urine (4+1).	8 Bal- ance (1-4).	9 Benzoic acid admin- istered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	5,634	125	559	684	2.25	10.08	12.33	4,950	0.0
Average.....	563	12	56	68				495	.0
Second subperiod:									
Total.....	5,654	131	580	711	2.32	10.25	12.57	4,943	.0
Average.....	565	13	58	71				494	.0
Entire fore period:									
Total.....	11,288	256	1,139	1,395	2.27	10.09	12.36	9,893	.0
Average.....	565	13	57	70				495	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	5,567	137	560	697	2.46	10.06	12.52	4,870	10.00
Average.....	557	14	56	70				487	1.00
Second subperiod:									
Total.....	5,522	110	570	680	1.99	10.32	12.31	4,842	15.00
Average.....	552	11	57	68				484	1.50
Third subperiod:									
Total.....	5,504	134	562	696	2.43	10.21	12.64	4,808	20.00
Average.....	550	13	56	69				481	2.00
Fourth subperiod:									
Total.....	5,491	114	572	686	2.07	10.42	12.49	4,805	25.00
Average.....	549	11	57	68				481	2.50
Entire preservative period:									
Total.....	22,084	495	2,264	2,759	2.24	10.25	12.49	19,325	70.00
Average.....	552	12	57	69				483	1.75
<i>After period.</i>									
First subperiod:									
Total.....	5,420	143	577	720	2.64	10.64	13.28	4,700	.0
Average.....	542	14	58	72				470	.0
Second subperiod:									
Total.....	5,428	124	510	634	2.28	9.40	11.68	4,794	.0
Average.....	542	12	51	63				479	.0
Entire after period:									
Total.....	10,848	267	1,087	1,354	2.46	10.02	12.48	9,494	.0
Average.....	542	13	54	67				475	.0



TABLE XVII.—*Solids balances for Series VIII—Continued.*

## SUMMARIES—Continued.

[Averages are per man per day.]

Nos. 1 to 6, inclusive, omitting No. 3.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Bal- ance (1-4).	9 Benzoic acid admin- istered.
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	14,132	437	1,385	1,822	3.09	9.80	12.89	12,310	0.0
Average.....	565	17	55	73				492	.0
Second subperiod:									
Total.....	14,363	470	1,433	1,903	3.27	9.98	13.25	12,460	.0
Average.....	574	19	57	76				498	.0
Entire fore period:									
Total.....	28,495	907	2,818	3,725	3.18	9.89	13.07	24,770	.0
Average.....	570	18	56	75				495	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	14,250	508	1,431	1,939	3.56	10.04	13.60	12,311	25.00
Average.....	570	20	57	77				493	1.00
Second subperiod:									
Total.....	14,044	436	1,490	1,926	3.10	10.61	13.71	12,118	37.50
Average.....	562	17	60	77				485	1.50
Third subperiod:									
Total.....	13,991	493	1,467	1,960	3.52	10.49	14.01	12,031	48.00
Average.....	560	20	58	78				482	1.92
First, second, and third sub- periods:									
Total.....	42,285	1,437	4,388	5,825	3.40	10.38	13.78	36,460	110.50
Average.....	565	19	59	78				487	1.47
<i>After period.</i>									
First subperiod:									
Total.....	13,818	513	1,435	1,948	3.71	10.38	14.09	11,870	.0
Average.....	553	21	57	78				475	.0
Second subperiod:									
Total.....	13,905	372	1,318	1,690	2.71	9.51	12.22	12,215	.0
Average.....	556	15	53	68				488	.0
Entire after period:									
Total.....	27,723	885	2,753	3,638	3.23	9.96	13.19	24,085	.0
Average.....	554	18	55	73				481	.0

TABLE XVII.—*Solids balances for Series VIII—Continued.*

## SUMMARIES—Continued.

[Averages are per man per day.]

Nos. 7 to 12, inclusive.

Period.	1	2	3	4	5	6	7	8	9
	In food.	In feces.	In urine.	In feces and urine (2+3).	In feces (2÷1).	In urine (3÷1).	In feces and urine (4÷1).	Balance (1-4).	Sodium benzoate administered (calculated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	17,270	612	1,789	2,401	3.54	10.36	13.90	14,869	0.0
Average.....	576	20	60	80				496	.0
Second subperiod:									
Total.....	18,019	466	1,732	2,198	2.59	9.61	12.20	15,821	.0
Average.....	601	16	58	74				527	.0
Entire fore period:									
Total.....	35,289	1,078	3,521	4,599	3.05	9.98	13.03	30,690	.0
Average.....	588	18	59	77				511	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	17,570	524	1,903	2,427	2.98	10.83	13.81	15,143	29.40
Average.....	586	17	63	80				506	.98
Second subperiod:									
Total.....	17,424	648	1,859	2,507	3.72	10.67	14.39	14,917	45.00
Average.....	581	22	62	84				497	1.50
Third subperiod:									
Total.....	17,200	449	1,897	2,346	2.61	11.03	13.64	14,854	58.00
Average.....	573	15	63	78				495	1.93
First, second, and third subperiods:									
Total.....	52,194	1,621	5,659	7,280	3.11	10.84	13.95	44,914	132.40
Average.....	580	18	63	81				499	1.47
<i>After period.</i>									
First subperiod:									
Total.....	17,266	591	1,797	2,388	3.42	10.41	13.83	14,878	.0
Average.....	576	20	60	80				496	.0
Second subperiod:									
Total.....	16,522	655	1,688	2,343	3.96	10.22	14.18	14,179	.0
Average.....	551	22	56	78				473	.0
Entire after period:									
Total.....	33,788	1,246	3,485	4,731	3.69	10.31	14.00	29,057	.0
Average.....	563	21	58	79				484	.0

TABLE XVII.—*Solids balances for Series VIII—Continued.*

SUMMARIES—Continued.

[Averages are per man per day.]

Nos. 1 to 12, inclusive, omitting No. 3.

Period.	1 In food.	2 In feces.	3 In urine.	4 In feces and urine (2+3).	5 In feces (2÷1).	6 In urine (3÷1).	7 In feces and urine (4÷1).	8 Balance (1-4).	9 Pre- serva- tive admin- istered (calcu- lated as benzoic acid).
<i>Fore period.</i>									
First subperiod:	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Grams.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Grams.</i>	<i>Grams.</i>
Total.....	31,402	1,049	3,174	4,223	3.34	10.11	13.45	27,179	0.0
Average.....	571	19	58	77				494	.0
Second subperiod:									
Total.....	32,382	936	3,165	4,101	2.89	9.77	12.66	28,281	.0
Average.....	589	17	58	75				514	.0
Entire fore period:									
Total.....	63,784	1,985	6,339	8,324	3.11	9.94	13.05	55,460	.0
Average.....	580	18	58	76				504	.0
<i>Preservative period.</i>									
First subperiod:									
Total.....	31,820	1,032	3,334	4,366	3.24	10.48	13.72	27,454	54.40
Average.....	579	19	61	80				499	.99
Second subperiod:									
Total.....	31,468	1,084	3,349	4,433	3.44	10.64	14.08	27,035	82.50
Average.....	572	20	60	80				492	1.50
Third subperiod:									
Total.....	31,191	942	3,364	4,306	3.02	10.78	13.80	26,885	106.00
Average.....	567	17	61	78				489	1.93
First, second, and third subperiods:									
Total.....	94,479	3,058	10,047	13,105	3.24	10.63	13.87	81,374	242.90
Average.....	573	19	61	80				493	1.47
<i>After period.</i>									
First subperiod:									
Total.....	31,084	1,104	3,232	4,336	3.55	10.40	13.95	26,748	.0
Average.....	565	20	59	79				486	.0
Second subperiod:									
Total.....	30,427	1,027	3,006	4,033	3.42	9.91	13.33	26,394	0
Average.....	553	19	55	73				480	.0
Entire after period:									
Total.....	61,511	2,131	6,238	8,369	3.49	10.16	13.65	53,142	.0
Average.....	559	19	57	76				483	.0

SUMMARY OF RESULTS.

MEDICAL AND CLINICAL DATA.

The observations made show that both benzoic acid and benzoate of soda, when administered to healthy young men in the quantities described, produce marked symptoms of discomfort and malaise in the majority of cases. There was little difference noted in the effect of the two forms of the preservative in the production of these symptoms. The most common symptoms are nausea and headache which occurred in nine and eight cases, respectively. The nausea resulted in vomiting in only three cases. Seven of the subjects com-

plained of weakness and also of burning and irritating sensations in the esophagus. Hunger was increased in three cases, and indigestion was especially noted five times.

The fact that these symptoms were not produced in all cases illustrated a point prominently brought out in the previous investigations, namely, the different degrees of toleration of the substance administered in different individuals. It should not be forgotten that the subjects upon whom the experiments were made represent the highest type of health and resistance. Hence, it is fair to infer that with less resistant types, such as children and persons with weak stomachs or other disorders of the digestive functions, or those suffering from impaired vitality in any form, the effects of the administration of the drug would have been more pronounced. It is evident, therefore, that the administration of both benzoic acid and benzoate of soda results in serious disturbances of the digestive functions, with positive indications of illness, which may easily be increased to nausea and vomiting, while headache is a very common symptom, developed together with a feeling of physical weakness and an unfitness to perform ordinary work.

#### BODY WEIGHT.

A study of the figures shows that in the case of the subjects who received benzoic acid there was an average loss of weight during the preservative period of about half a kilogram, or slightly more than one pound, and an additional loss during the after period of 0.46 kilogram, again a loss of about a pound. The loss in weight of those who received benzoate of soda was very much less, amounting to 0.22 kilogram, or about 0.5 pound, during the preservative period, and an additional loss of about 0.36 kilogram during the after period, making altogether a total average loss of 1.3 pounds for the entire observation. This illustrates a fact which is brought out in nearly all of the other studies, namely, that while the immediate effect of benzoate of soda on the metabolic activities was less marked than that of benzoic acid, the effect, after the withdrawal of the preservative, was more pronounced, so that the final result was almost as injurious as that produced by the benzoic acid alone.

The final conclusion, which is drawn from a study of these data, is that the administration of benzoic acid as such, or sodium benzoate, in the quantities mentioned, produces a condition of the digestive activities which causes a loss in the weight of the body. In other words, the activities of a katabolic nature, which result in the destruction and excretion of tissue, are greater than those of an anabolic nature, which build up the tissues. This effect does not cease immediately upon the withdrawal of the preservative, but is continued in the majority of the cases throughout the entire after period. Hence, it is evident that



the administration of these drugs in foods tends to derange the normal activities of the body and to cause a loss of tissue, resulting not only in disturbances of health but also in a slight decrease in the weight of the body.

#### EXCRETION OF BENZOIC AND HIPPURIC ACIDS.

Hippuric acid is the most important natural constituent of the urine of herbivorous animals whose food contains large quantities of aromatic substances which, either by oxidation or reduction, are converted into bodies containing the benzene nucleus. The benzene nucleus by combination with glycocholic acid is converted into hippuric acid, in which form it is excreted. Hippuric acid is a normal constituent of the urine and the data show a fact, already well recognized by physiologists, namely, that the administration of benzoic acid or benzoate of soda to the human animal increases the quantity of hippuric acid so excreted. The limit of conversion of benzoic acid into hippuric acid is determined by the quantity of available glycocholic acid. Any excess of benzoic acid over the quantity which can thus be converted into hippuric acid is excreted as benzoic acid.

In the original experiment the total benzoic acid recovered (both as hippuric and as benzoic acid) amounts in the case of those receiving benzoic acid, to 81.32 per cent of the total quantity ingested, while for those receiving sodium benzoate the total quantity amounts to 61.41 per cent. Thus there is shown a marked tendency to restrict the excretion of benzoic acid when administered as benzoate of soda, the total decrease being almost exactly 20 per cent as compared with the excretion of benzoic acid. It is thus seen that much larger quantities of benzoic acid are retained in the system after a given time when administered as benzoate of soda than when administered as benzoic acid. This fact is another confirmation of what is shown in so many other instances in this study of the retarded effect of the preservative upon the system when administered as benzoate of soda.

The results of the supplemental study conducted with six subjects over a period of twenty-nine days (a fore period of five days, a preservative period of ten days, and an after period of fourteen days), and a smaller ingestion of the preservative (a total of 12.5 grams), again showed the slower elimination of the preservative when administered as benzoate of soda. During the preservative period 93 per cent of the amount ingested as benzoic acid was recovered as hippuric acid, while for those receiving benzoate of soda only 72 per cent was recovered. The differing conditions of the two experiments, especially the decreased amount of preservative and the fact that the analyses in the second case were made on the daily samples instead of

the composites, account largely for the fact that all of the benzoic acid was recovered as hippuric acid in the supplemental study. At the close of the first after subperiod the entire amount of benzoic acid ingested had been recovered, while in the case of those receiving benzoate of soda only 76 per cent had been recovered. The increased excretion of hippuric acid as compared with the fore period continued in the case of these subjects in the second after subperiod but only reached 77.6 per cent of the amount ingested. There is in this series, as in the preceding one, about 20 per cent less of the benzoic acid recovered when it is ingested as sodium benzoate.

The increase in the quantity of hippuric acid produced and excreted can not be neglected in studying the effects of the administration of preservatives upon health and digestion. The preservatives can only be regarded as foreign bodies of a toxic character which the system must eliminate. The normal burden imposed upon the kidneys in the excretion of the natural degradation products of metabolism is quite sufficient for the preservation of their healthy activity. The additional amount of excretory matter produced by the administration of benzoic acid in any form can only be regarded as an unnecessary burden.

#### COMPOSITION OF THE FECES.

In the case of the young men who received benzoic acid a slight increase in the weight of the moist feces is shown in the preservative period, together with a slight decrease in the percentage of moisture therein and, of course, a corresponding increase in the weight of the dry feces. In the after period there is a marked loss in the weight of the moist feces and a continued diminution in the percentage of moisture, while the weight of the dry feces is slightly decreased, returning to the amount found in the fore period. These data show that the effect of the benzoic acid was to inhibit slightly the absorption of food material from the alimentary canal and thus to increase the quantity of feces excreted.

In the case of the young men receiving the benzoate of soda the data show a slight increase in the weight of the moist feces, and also of the percentage of moisture therein, while the amount of dry feces excreted is the same as in the fore period. In the after period there is a marked increase in the weight of the moist feces, with little change in the water content, and a correspondingly marked increase in the weight of the dry feces excreted. The benzoate of soda, therefore, appears to have had no immediate effect upon the absorption from the alimentary canal, but upon the withdrawal of the drug a diminished absorption took place. This is another indication of the retarded effect of the benzoate of soda. In almost every instance the data submitted show that the effect of the benzoate of soda

upon the system is less marked and is produced more tardily than in the case of the benzoic acid. These data do not show that the preservative has produced any marked effect of a systematic character upon the weight and water content of the feces. The average weight of dry feces per man per day increased very slightly (1 gram) in the preservative period in the case of those receiving benzoic acid, and 3 grams in the after period in the case of the six men who received benzoate of soda. While these data are not sufficiently marked to demonstrate a distinct effect produced by the preservative, still the small average increase in the feces in connection with the loss of body weight would indicate a tendency on the part of the preservative to decrease assimilation.

### THE URINE.

#### VOLUME, SPECIFIC GRAVITY, AND TOTAL SOLIDS.

The summary of the data for the men receiving benzoic acid shows a very slight decrease in the volume of the urine with a slight increase in its specific gravity, and an increase in the total solids in the preservative period followed by a decrease in the after period.

In the case of the subjects who received benzoate of soda there is also observed a slight decrease in the volume of the urine during the preservative period, but the volume in the after period remains practically unchanged as compared with the preservative period. The specific gravity is slightly higher in the preservative period than in either the fore or after periods.

The total solids in the urine of those receiving benzoate of soda are markedly increased during the preservative period, and fall again in the after period, but do not reach the figure obtained in the fore period. The data show but little influence upon the volume of the urine due to the preservative, especially as during the progress of the experiment the weather was growing warmer, and this naturally would cause a slight decrease in volume. There is, however, a marked tendency shown to increase the amount of total solids excreted under the influence of the preservative.

It is evident that neither benzoic acid nor benzoate of soda has any diuretic effect, but their influence in promoting the degradation of the tissues of the body—that is, in increasing katabolic activity—is plainly marked by the increase in the total solids excreted in the urine, although the volume of the urine is slightly diminished.

#### SULPHUR.

Under the administration of the preservative in both forms, there is a slight tendency to decrease the excretion of sulphur and phosphoric acid in relation to the quantity of nitrogen excreted, while no



effect is produced upon the excretion of sulphates in the urine as compared with the nitrogen excreted, due to the fact that the inorganic sulphates and the nitrogen in the urine increase in about the same ratio.

In general, there is practically no difference in the effect produced by the preservative in the two forms on the excretion of sulphur in the urine. A slight tendency is manifested in both cases to increase the katabolic activities as shown by the greater excretion of metabolized sulphur in the preservative period. This increase is the more pronounced when the diminution in the sulphur ingested is considered. The amount of neutral sulphur eliminated decreases throughout the observation, while the ethereal sulphates are remarkably constant. It is evident, therefore, that the increased excretion of total sulphur is entirely in the inorganic form, which, considered in connection with the decrease in body weight, would lead to the conclusion that the preservative tends to increase sulphur katabolism.

#### MICROSCOPICAL EXAMINATION OF THE URINE.

The data relating to the microscopical examination of the urine show that the relative occurrence of microscopic bodies in the fore period, preservative period, and after period are represented by the numbers 64.44, 75.24, and 59.13, respectively. These figures indicate a tendency on the part of the benzoic acid and the benzoate of soda to increase the presence of these microscopic bodies during the preservative period. This is an indication of the effect of these bodies to increase the renal activity.

A general survey of the individual data does not show a marked effect in the case of all these bodies, but the epithelial cells, mucous strands, and mucous cylindroids are most markedly increased. The activities of the kidneys are, therefore, undoubtedly greater during the preservative period, owing to the additional amount of labor which they are called upon to perform in eliminating the products of tissue degradation. The microscopical examination of the urine, therefore, further indicates the deleterious effects of both benzoic acid and benzoate of soda on metabolism.

#### MICROSCOPICAL EXAMINATION OF THE BLOOD.

In making the investigations in connection with the influence of benzoic acid and benzoates no particular significance was attached to the blood count and for this reason the microscopical examinations were confined to one test in each of the three periods—fore, preservative, and after. The results of the examinations, however, are so significant as to render necessary another study in greater detail, which will be undertaken as soon as possible. The



limited data obtained show a marked tendency on the part of the benzoic acid to diminish the number of red corpuscles in the blood (an average decrease per man of 370,000 per cubic millimeter), while on the contrary, when administered in the form of benzoate of soda the tendency is to increase the number of red corpuscles in the blood to the same extent. There is also in the latter case a slight increase in the number of white corpuscles.

In one instance in the administration of benzoic acid the number of red corpuscles was increased, while in two instances in the administration of benzoate of soda the number of red corpuscles was decreased. Therefore, in the interpretation of the data these facts must be kept in mind. While the general effect of the benzoic acid appears to be to diminish the number of red corpuscles, and that of the benzoate of soda to increase the number, there are marked exceptions in the individual data. It may be further suggested in this connection that the tendency to increase the red corpuscles shown by the benzoate of soda may have been due to the increased alkalinity of the blood, induced by the soda, rather than from any specific action of the compound as a whole.

#### NITROGEN METABOLISM.

The percentage data show an increase in the nitrogen excreted both in the urine and in the feces during the preservative period, and there is a decrease in the after period in each case, with the exception of the nitrogen in the feces for those members who received benzoate of soda. While the average data do not show any marked disturbance of the nitrogen metabolism there is a uniform tendency to decrease the nitrogen balance, although the amounts ingested were slightly increased. The average data for the eleven men show an increase of 2 per cent in the preservative period of the amount of ingested nitrogen excreted in metabolized form, indicating a tendency to increase to this extent the katabolic activities, while the increase in the feces points to a decrease in nitrogen assimilation.

#### PHOSPHORIC ACID METABOLISM.

The summarized data in this case indicate a tendency on the part of the preservative in both forms to increase the percentage of phosphoric acid excreted in the feces, the increase being much more marked in the case of those receiving benzoic acid, the increase in the case of those receiving benzoate of soda occurring chiefly in the after period. There is but little change in the metabolized phosphoric acid excreted in the case of those who received benzoic acid, the percentage data showing a slight decrease in the preservative period and a very marked decrease in the after period. In the case of those who received benzoate of soda there is an increased excretion of phosphoric

acid in the urine in the preservative period and a marked decrease in the after period. These figures indicate, therefore, that the benzoic acid, either in the form of the free acid or as benzoate of soda, tends to increase the phosphoric acid in the feces, which effect is continued to a marked degree in the after period. In other words, a decrease in the assimilation of phosphoric acid is produced. On the other hand, there is practically no tendency to increase katabolism in this instance, the slight increase in the excretion in the urine in the case of those receiving sodium benzoate being followed by a marked decrease in the after period to an amount less than in the fore period. There appears to be a slight disturbance of the normal metabolism of phosphoric acid.

### SULPHUR METABOLISM.

These data show in an unmistakable manner that both the benzoic acid and the benzoate of soda increase the excretion in the feces and in the urine, thus establishing the effect of the preservative in decreasing the assimilation of sulphur and slightly increasing the sulphur katabolism. In the case of those receiving benzoic acid there is a tendency in the after period to return to the conditions of the fore period, while in the case of the members who received sodium benzoate there is a further marked increase in the after period. The increased excretion of metabolized sulphur is considered in detail under the special studies on the urine.

TABLE XVIII.—Comparative summary of principal determinations made, Series VIII.<sup>a</sup>

Data.	Benzoic acid (Nos. 1-6). <sup>b</sup>			Sodium benzoate calculated as benzoic acid (Nos. 7-12).		
	Fore period.	Preservative period.	After period.	Fore period.	Preservative period.	After period.
Body weight (kilos).....	62.10	61.62	61.16	64.24	64.02	63.66
Blood (averages per man):						
Red corpuscles (per cubic mm) . . . . .	5,249,000	4,878,333	5,229,167	4,943,333	5,320,833	5,280,833
White corpuscles (per cubic mm) . . . . .	7,567	7,202	6,583	7,322	7,461	6,704
Composition of feces:						
Weight (grams).....	74	76	68	74	77	89
Water content (per cent).....	75.37	74.78	73.84	75.72	76.56	76.72
Dry matter (grams).....	18	19	18	18	18	21
Urine:						
Volume (cc).....	997	992	922	1,248	1,206	1,205
Microscopic sediment (per cent of relative occurrence) <sup>c</sup> .....	64.44	75.24	59.13			
Sulphur, as SO <sub>3</sub> (grams)—						
Neutral.....	.327	.289	.238	.304	.278	.237
Inorganic.....	1.762	1.840	1.729	1.765	1.855	1.770
Etheral.....	.158	.156	.148	.155	.152	.139
Total.....	2.247	2.285	2.112	2.223	2.281	2.146
Metabolism (percentage results):						
Nitrogen—						
Nonmetabolized (feces).....	7.69	8.01	7.68	6.93	7.00	8.54
Metabolized (urine).....	86.82	87.70	85.61	79.78	82.57	81.69
Phosphoric acid—						
Nonmetabolized (feces).....	26.56	29.65	29.08	28.59	28.61	34.73
Metabolized (urine).....	63.66	63.27	58.06	55.95	56.42	52.56
Sulphur—						
Nonmetabolized (feces).....	9.76	10.58	10.42	8.62	9.23	11.75
Metabolized (urine).....	79.16	82.19	81.80	73.21	76.78	78.50

<sup>a</sup> Omitting fourth preservative subperiod.

<sup>b</sup> Omitting No. 3.

<sup>c</sup> Nos. 1 to 12.

## GENERAL CONCLUSIONS.

From a careful study of the data in the individual cases and of the summaries of the results, it is evident that the administration of benzoic acid, either as such or in the form of benzoate of soda, is highly objectionable and produces a very serious disturbance of the metabolic functions, attended with injury to digestion and health.

As in the case of boric acid, salicylic acid, and sulphurous acid, this injury manifests itself in a number of different ways, both in the production of unfavorable symptoms and in the disturbance of metabolism. These injurious effects are evident in the medical and clinical data which show grave disturbances of digestion, attended by phenomena which are clearly indicative of irritation, nausea, headache, and in a few cases vomiting. These symptoms were not only well marked, but they were produced upon healthy individuals receiving good and nourishing food and living under proper sanitary conditions. It is only fair to conclude, therefore, that under similar conditions of administration of benzoic acid or benzoate of soda in the case of weaker systems, or less resistant conditions of health, much more serious and lasting injury would be produced.

It was also noticed that the administration of benzoic acid and benzoate of soda was attended with a distinct loss of weight, indicative of either a disturbance of assimilation or an increased activity in those processes of the body which result in destruction of tissue. The production of a loss of weight in cases of this kind must be regarded as indicative of injurious effects.

The influence of the benzoic acid and benzoate of soda upon metabolism was never of a character indicative of a favorable change therein. While often the metabolic changes were not strongly marked, such changes as were established were of an injurious nature. It is evident that the administration of these bodies, therefore, in the food tends to derange metabolism in an injurious way.

An important fact in connection with the administration of these bodies is found in the efforts which nature makes to eliminate them from the system. In so far as possible the benzoic acid is converted into hippuric acid. There is a tendency usually manifested, however, to retain the benzoic acid in the body for a notable length of time, and this is much more marked in the case of benzoate of soda than in the case of benzoic acid.

While the administration of both these bodies, therefore, is undoubtedly harmful, the injurious effects are produced more rapidly in the case of benzoic acid than they are in the case of benzoate of soda; the data, however, will show that the total harmful effect produced in the end is practically the same in both cases, hence



there appears to be no reason for supposing that the administration of the preservative in the form of benzoate of soda can be justified by any argument relating to the less injurious effect thereof upon health.

The occurrence of microscopic bodies in the urine is undoubtedly increased under the administration of benzoic acid in both forms, thus showing conclusively the tendency to stimulate the destructive activities of the body.

Coming to the final consideration of all of these different phases of the subject, there is only one conclusion to be drawn from the data which have been presented and that is that in the interests of health both benzoic acid and benzoate of soda should be excluded from food products. This conclusion is reached independently of any consideration of the conditions which it is alleged surround the processes of manufacture and which result in the demands of manufacturers to be allowed to continue the use of these substances. This is a subject which must be discussed from an entirely different point of view and has no bearing whatever upon the general conclusions which have been reached, namely, that both benzoic acid and benzoate of soda are bodies which, when added to foods, are injurious to health.

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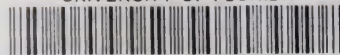








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